SUPPLEMENT

TO THE

ENCYCLOPÆDIA BRITANNICA.

SUPPLEMENT

TO THE

FOURTH, FIFTH, AND SIXTH EDITIONS

OF THE

ENCYCLOPÆDIA BRITANNICA.

WITH PRELIMINARY DISSERTATIONS

ON THE

HISTORY OF THE SCIENCES.

Illustrated by Engravings.

VOLUME FIFTH.

EDINBURGH:

PRINTED FOR ARCHIBALD CONSTABLE AND COMPANY, EDINBURGH;

AND HURST, ROBINSON, AND COMPANY,

LONDON.

1824.

DISSERTATION FIRST:

EXHIBITING A GENERAL VIEW

OF THE

PROGRESS OF METAPHYSICAL, ETHICAL, AND POLITICAL PHILOSOPHY,

SINCE THE REVIVAL OF LETTERS IN EUROPE.

PART II.

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ADVERTISEMENT.

Some apology, I am afraid, is necessary for the length to which this Dissertation has already extended. My original design (as is well known to my friends) was to comprise in ten or twelve sheets all the preliminary matter which I was to contribute to this Supplement. But my work grew insensibly under my hands, till it assumed a form which obliged me either to destroy all that I had written, or to continue my Historical Sketches on the same enlarged scale. In selecting the subjects on which I have chiefly dwelt, I have been guided by my own idea of their pre-eminent importance, when considered in connection with the present state of Philosophy in Europe. On some, which I have passed over unnoticed, it was impossible for me to touch, without a readier access to public libraries than I can command in this retirement. The same circumstance will, I trust, account, in the opinion of candid readers, for various other omissions in my performance.

The time unavoidably spent in consulting, with critical care, the numerous Authors referred to in this and in the former part of my Discourse, has encroached so deeply, and to myself so painfully, on the leisure which I had destined for a different purpose, that, at my advanced years, I can entertain but a very faint expectation (though I do not altogether abandon the hope) of finishing my intended Sketch of the Progress of Ethical and Political Philosophy during the Eighteenth Century. An undertaking of a much earlier date has a prior and stronger claim on my attention. At all events, whatever may be wanting to complete my plan, it cannot be difficult for another hand to supply. An Outline is all that should be attempted on such a subject; and the field which it has to embrace will be found incomparably more interesting to most readers than that which has fallen under my review.

Kinneil House, August 7, 1821.

DISSERTATION FIRST.

PART II.

In the farther prosecution of the plan of which I traced the outline in the Preface to the First Part of this Dissertation, I find it necessary to depart considerably from the arrangement which I adopted in treating of the Philosophy of the seventeenth century. During that period, the literary intercourse between the different nations of Europe was comparatively so slight, that it seemed advisable to consider, separately and successively, the progress of the mind in England, in France, and in Germany. But from the era at which we are now arrived, *the Republic of Letters* may be justly understood to comprehend, not only these and other countries in their neighbourhood, but every region of the civilised earth. Disregarding, accordingly, all diversities of language and of geographical situation, I shall direct my attention to the intellectual progress of the species in general; enlarging, however, chiefly on the Philosophy of those parts of Europe, from whence the rays of science have, in modern times, diverged to the other quarters of the globe. I propose also, in consequence of the thickening crowd of useful authors, keeping pace in their numbers with the diffusion of knowledge and of liberality, to allot separate discourses to the history of Metaphysics, of Ethics, and of Politics; a distribution which, while it promises a more distinct and connected view of these different subjects, will furnish convenient resting-places, both to the writer and to the reader, and can scarcely fail to place, in a stronger and more concentrated light, whatever general conclusions may occur in the course of this survey.

The foregoing considerations, combined with the narrow limits assigned to the sequel of my work, will sufficiently account for the contracted scale of some of the following

sketches, when compared with the magnitude of the questions to which they relate, and the peculiar interest which they derive from their immediate influence on the opinions of our own times.

In the case of Locke and Leibnitz, with whom the metaphysical history of the eighteenth century opens, I mean to allow myself a greater degree of latitude. The rank which I have assigned to both in my general plan seems to require, of course, a more ample space for their leading doctrines, as well as for those of some of their contemporaries and immediate successors, than I can spare for metaphysical systems of a more modern date; and as the rudiments of the most important of these are to be found in the speculations either of one or of the other, I shall endeavour, by connecting with my review of their works, those longer and more abstract discussions which are necessary for the illustration of fundamental principles, to avoid, as far as possible, in the remaining part of my discourse, any tedious digressions into the thorny paths of scholastic controversy. The critical remarks, accordingly, which I am now to offer on their philosophical writings, will, I trust, enable me to execute the very slight sketches which are to follow in a manner at once more easy to myself, and more satisfactory to the bulk of my readers.

But what I have chiefly in view in these preliminary observations, is to correct certain misapprehensions concerning the opinions of Locke and of Leibnitz, which have misled (with very few exceptions) all the later historians who have treated of the literature of the eighteenth century. I have felt a more particular solicitude to vindicate the fame of Locke, not only against the censures of his opponents, but against the mistaken comments and eulogies of his admirers, both in England and on the Continent. Appeals to his authority are so frequent in the reasonings of all who have since canvassed the same subjects, that, without a precise idea of his distinguishing tenets, it is impossible to form a just estimate, either of the merits or demerits of his successors. In order to assist my readers in this previous study, I shall endeavour, as far as I can, to make Locke his own commentator; earnestly intreating them, before they proceed to the sequel of this dissertation, to collate carefully those scattered extracts from his works, which, in the following section, they will find brought into contact with each other, with a view to their mutual illustration. My own conviction, I confess, is, that the *Essay on Human Understanding* has been much more generally applauded than read; and if I could only flatter myself with the hope of drawing the attention of the public from the glosses of commentators to the author's text, I should think that I had made a considerable step towards the correction of some radical and prevailing errors, which the supposed sanction of his name has hitherto sheltered from a free examination.

PROGRESS OF METAPHYSICS DURING THE EIGHTEENTH CENTURY.

SECTION I.

Historical and Critical Review of the Philosophical Works of Locke and Leibnitz.

LOCKE.

BEFORE entering on the subject of this section, it is proper to premise, that, although my design is to treat separately of Metaphysics, Ethics, and Politics, it will be impossible to keep these sciences wholly unmixed in the course of my reflections. They all run into each other by insensible gradations; and they have all been happily united in the comprehensive speculations of some of the most distinguished writers of the eighteenth century. The connection between Metaphysics and Ethics is more peculiarly close; the theory of Morals having furnished, ever since the time of Cudworth, several of the most abstruse questions which have been agitated concerning the general principles, both intellectual and active, of the human frame. The inseparable affinity, however, between the different branches of the Philosophy of the Mind, does not afford any argument against the arrangement which I have adopted. It only shows, that it cannot, in every instance, be rigorously adhered to. It shall be my aim to deviate from it as seldom, and as slightly, as the miscellaneous nature of my materials will permit.

JOHN LOCKE, from the publication of whose *Essay on Human Understanding* a new era is to be dated in the History of Philosophy, was born at Wrington in Somersetshire, in 1632. Of his father nothing remarkable is recorded, but that he was a captain in the Parliament's army during the civil wars; a circumstance which, it may be presumed from the son's political opinions, would not be regarded by him as a stain on the memory of his parent.

In the earlier part of Mr Locke's life, he prosecuted for some years, with great ardour, the study of medicine; an art, however, which he never actually exercised as a profession. According to his friend Le Clerc, the delicacy of his constitution rendered this impossible. But, that his proficiency in the study was not inconsiderable, we have good evidence in the dedication prefixed to Dr Sydenham's *Observations on the History and Cure of Acute*

Diseases;[1] where he boasts of the approbation bestowed on his METHOD by Mr Jo. Locke, who (to borrow Sydenham's own words) "examined it to the bottom; and who, if we consider his genius and penetrating and exact judgment, has scarce any superior, and few equals, now living." The merit of this METHOD, therefore, which still continues to be regarded as a model by the most competent judges, may be presumed to have belonged *in part* to Mr Locke,[2]—a circumstance which deserves to be noticed, as an additional confirmation of what Bacon has so sagaciously taught, concerning the dependence of all the sciences relating to the phenomena, either of Matter or of Mind, on principles and rules derived from the resources of a higher philosophy. On the other hand, no science could have been chosen, more happily calculated than Medicine, to prepare such a mind as that of Locke for the prosecution of those speculations which have immortalized his name; the complicated and fugitive, and often equivocal phenomena of disease, requiring in the observer a far greater portion of discriminating sagacity, than those of Physics, strictly so called; resembling, in this respect, much more nearly, the phenomena about which Metaphysics, Ethics, and Politics, are conversant.

I have said, that the study of Medicine forms one of the best preparations for the study of mind, *to such an understanding as Locke's.* To an understanding less comprehensive, and less cultivated by a liberal education, the effect of this study is likely to be similar to what we may trace in the works of Hartley, Darwin, and Cabanis; to all of whom we may more or less apply the sarcasm of Cicero on Aristoxenus, the Musician, who attempted to explain the nature of the soul by comparing it to a *Harmony;* HIC AB ARTIFICIO SUO NON RECESSIT.[3] In Locke's *Essay*, not a single passage occurs, savouring of the Anatomical Theatre, or of the Chemical Laboratory.

In 1666, Mr Locke, then in his thirty-fifth year, formed an intimate acquaintance with Lord Ashley, afterwards Earl of Shaftesbury; from which period a complete change took place, both in the direction of his studies, and in his habits of life. His attention appears to

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[1] Published in the year 1676.

[2] It is remarked of Sydenham, by the late Dr John Gregory, "That though full of hypothetical reasoning, it had not the usual effect of making him less attentive to observation; and that his hypotheses seem to have sat so loosely about him, that either they did not influence his practice at all, or he could easily abandon them, whenever they would not bend to his experience."

This is precisely the idea of Locke concerning the true use of hypotheses. "Hypotheses, if they are well made, are at least great helps to the memory, and often direct us to new discoveries." Locke's *Works*, Vol. III. p. 81. See also some remarks on the same subject in one of his letters to Mr Molyneux. (The edition of Locke to which I uniformly refer, is that printed at London in 1812, in Ten Volumes 8vo.)

[3] Tusc. Quæst. Lib. I.

been then turned, for the first time, to political subjects; and his place of residence transferred from the university to the metropolis. From London (a scene which gave him access to a society very different from what he had previously lived in[1]) he occasionally passed over to the Continent, where he had an opportunity of profiting by the conversation of some of the most distinguished persons of his age. In the course of his foreign excursions, he visited France, Germany, and Holland; but the last of these countries seems to have been his favourite place of residence; the blessings which the people there enjoyed, under a government peculiarly favourable to civil and religious liberty, amply compensating, in his view, for what their uninviting territory wanted in point of scenery and of climate. In this respect, the coincidence between the taste of Locke and that of Descartes throws a pleasing light on the characters of both.

The plan of the *Essay on Human Understanding* is said to have been formed as early as 1670; but the various employments and avocations of the Author prevented him from finishing it till 1687, when he fortunately availed himself of the leisure which his exile in Holland afforded him, to complete his long meditated design. He returned to England soon after the Revolution, and published the first edition of his work in 1690; the busy and diversified scenes through which he had passed during its progress, having probably contributed, not less than the academical retirement in which he had spent his youth, to enhance its peculiar and characteristical merits.

Of the circumstances which gave occasion to this great and memorable undertaking, the following interesting account is given in the *Prefatory Epistle to the Reader*. "Five or six friends, meeting at my chamber, and discoursing on a subject very remote from this, found themselves quickly at a stand, by the difficulties that rose on every side. After we had a while puzzled ourselves, without coming any nearer a resolution of those doubts which perplexed us, it came into my thoughts that we took a wrong course, and that, before we set ourselves upon inquiries of that nature, it was necessary to examine our own abilities, and see what objects our understandings were, or were not, fitted to deal with. This I proposed to the company, who all readily assented, and thereupon it was agreed, that this should be our first inquiry. Some hasty and undigested thoughts on a subject I had never before considered, which I set down against our next meeting, gave the first entrance into this discourse, which having been thus begun by chance, was continued by entreaty; written by incoherent parcels, and, after long intervals of neglect, resumed again

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[1] Villiers Duke of Buckingham, and the Lord Halifax, are particularly mentioned among those who were delighted with his conversation.

as my humour or occasions permitted; and at last in retirement, where an attendance on my health gave me leisure, it was brought into that order thou now seest it."

Mr Locke afterwards informs us, that "when he first put pen to paper, he thought all he should have to say on this matter would have been contained in one sheet, but that the farther he went the larger prospect he had;—new discoveries still leading him on, till his book grew insensibly to the bulk it now appears in."

On comparing the *Essay on Human Understanding* with the foregoing account of its origin and progress, it is curious to observe, that it is the fourth and last book alone which bears directly on the author's principal object. In this book, it is further remarkable, that there are few, if any, references to the preceding parts of the Essay; insomuch that it might have been published separately, without being less intelligible than it is. Hence, it seems not unreasonable to conjecture, that it was the *first* part of the work in the order of composition, and that it contains those leading and fundamental thoughts which offered themselves to the author's mind, when he first began to reflect on the friendly conversation which gave rise to his philosophical researches. The inquiries in the first and second books, which are of a much more abstract, as well as scholastic, nature, than the sequel of the work, probably opened gradually on the author's mind, in proportion as he studied his subject with a closer and more continued attention. They relate chiefly to the origin and to the technical classification of our ideas, frequently branching out into *collateral*, and sometimes into *digressive*, discussions, without much regard to method or connection The third book (by far the most important of the whole), where the nature, the use, and the abuse of language are so clearly and happily illustrated, seems, from Locke's own account, to have been a sort of *after-thought*; and the two excellent chapters on the *Association of Ideas* and on *Enthusiasm* (the former of which has contributed, as much as any thing else in Locke's writings, to the subsequent progress of Metaphysical Philosophy) were printed, for the first time, in the fourth edition of the Essay.

I would not be understood, by these remarks, to undervalue the two first books. All that I have said amounts to this, that the subjects which they treat of are seldom susceptible of any practical application to the conduct of the understanding; and that the author has adopted a new phraseology of his own, where, in some instances, he might have much more clearly conveyed his meaning without any departure from the ordinary forms of speech. But although these considerations render the two first books inferior in point of general utility to the two last, they do not materially detract from their merit, as a precious accession to the theory of the Human Mind. On the contrary, I do not hesitate to consider them as the richest contribution of well-observed and well-described facts, which

was ever bequeathed to this branch of science by a single individual; and as the indisputable (though not always acknowledged) source of some of the most refined conclusions, with respect to the intellectual phenomena, which have been since brought to light by succeeding inquirers.

After the details given by Locke himself, of the circumstances in which his Essay was begun and completed; more especially, after what he has stated of the "discontinued way of writing," imposed on him by the avocations of a busy and unsettled life, it cannot be thought surprising, that so very little of method should appear in the disposition of his materials; or that the opinions which, on different occasions, he has pronounced on the same subject, should not always seem perfectly steady and consistent. In these last cases, however, I am inclined to think that the inconsistencies, if duly reflected on, would be found rather apparent than real. It is but seldom that a writer, possessed of the powerful and upright mind of Locke, can reasonably be suspected of stating propositions in direct contradiction to each other. The presumption is, that, in each of these propositions, there is a mixture of truth, and that the error lies chiefly in the unqualified manner in which the truth is stated; proper allowances not being made, during the fervour of composition, for the partial survey taken of the objects from a particular point of view. Perhaps it would not be going too far to assert, that *most* of the seeming contradictions which occur in authors animated with a sincere love of truth, might be fairly accounted for by the different aspects which the same object presented to them upon different occasions. In reading such authors, accordingly, when we meet with discordant expressions, instead of indulging ourselves in the captiousness of verbal criticism, it would better become us carefully and candidly to collate the questionable passages; and to study so to reconcile them by judicious modifications and corrections, as to render the oversights and mistakes of our illustrious guides subservient to the precision and soundness of our own conclusions. In the case of Locke, it must be owned, that this is not always an easy task, as the limitations of some of his most exceptionable propositions are to be collected, not from the context, but from different and widely separated parts of his Essay.[1]

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[1] That Locke himself was sensible that some of his expressions required explanation, and was anxious that his opinions should be judged of rather from the general tone and spirit of his work, than from detached and isolated propositions, may be inferred from a passage in one of his notes, where he replies to the animadversions of one of his antagonists (the Reverend Mr Lowde), who had accused him of calling in question the immutability of moral distinctions. "But (says Locke) the good man does well, and as becomes his calling, to be watchful in such points, and to take the alarm, even at expressions, which, standing alone by themselves, might sound ill, and be suspected." (Locke's *Works*, Vol. II. p. 93. Note.)

In a work thus composed *by snatches* (to borrow a phrase of the author's), it was not to be expected, that he should be able accurately to draw the line between his own ideas, and the hints for which he was indebted to others. To those who are well acquainted with his speculations, it must appear evident, that he had studied diligently the metaphysical writings both of Hobbes and of Gassendi; and that he was no stranger to the *Essays* of Montaigne, to the philosophical works of Bacon, or to Malebranche's *Inquiry after Truth.*[1] That he was familiarly conversant with the Cartesian system may be presumed from what we are told by his biographer, that it was *this* which first inspired him with a disgust at the jargon of the schools, and led him into that train of thinking which he afterwards prosecuted so successfully. I do not, however, recollect that he has anywhere in his Essay mentioned the name of any one of these authors.[2] It is probable, that, when he sat down to write, he found the result of his youthful reading so completely identified with the fruits of his subsequent reflections, that it was impossible for him to attempt a separation of the one from the other; and that he was thus occasionally led to mistake the treasures of memory for those of invention. That this was really the case, may be farther presumed from the peculiar and original cast of his phraseology, which, though in general careless and unpolished, has always the merit of that characteristical unity and *raciness* of style, which demonstrate, that, while he was writing, he conceived himself to be drawing only from his own resources.

With respect to his style, it may be further observed, that it resembles that of a well educated and well informed man of the world, rather than of a recluse student who had made an object of the art of composition. It everywhere abounds with colloquial expressions, which he had probably caught by the ear from those whom he considered as models of good conversation; and hence, though it now seems somewhat antiquated, and not altogether suited to the dignity of the subject, it may be presumed to have contributed its share towards this great object of turning the thoughts of his contemporaries to logical and metaphysical inquiries. The author of the *Characteristics,* who will not be accused of an un-

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[1] Mr Addison has remarked, that Malebranche had the start of Locke, by several years, in his notions on the subject of *Duration.* (Spectator, No. 94.) Some other coincidences, not less remarkable, might be easily pointed out in the opinions of the English and of the French philosopher.

[2] The name of Hobbes occurs in Mr Locke's *Reply to the Bishop of Worcester.* See the Notes on his Essay, b. iv. c. 3. It is curious that he classes Hobbes and Spinoza together, as writers of the same stamp; and that he disclaims any intimate acquaintance with the works of either. "I am not so well read in *Hobbes* and *Spinoza* as to be able to say what were their opinions in this matter, but possibly there be those who will think your Lordship's authority of more use than those justly decried names," &c. &c.

due partiality for Locke, acknowledges, in strong terms, the favourable reception which his book had met with among the higher classes. "I am not sorry, however," says Shaftesbury, to one of his correspondents, "that I lent you Locke's Essay, a book that may as well qualify men for business and the world, as for the sciences and a university. No one has done more towards the recalling of philosophy from barbarity, into use and practice of the world, and into the company of the better and politer sort, who might well be ashamed of it in its other dress. No one has opened a better and clearer way to reasoning."[1]

In a passage of one of Warburton's letters to Hurd, which I had occasion to quote in the first part of this Dissertation, it is stated as a fact, that "when Locke first published his Essay, he had neither followers nor admirers, and hardly a single approver." I cannot help suspecting very strongly the correctness of this assertion, not only from the flattering terms in which the Essay is mentioned by Shaftesbury in the foregoing quotation, and from the frequent allusions to its doctrines by Addison and other popular writers of the same period, but from the unexampled sale of the book, during the fourteen years which elapsed between its publication and Locke's death. Four editions were printed in the space of ten years, and three others must have appeared in the space of the next four; a reference being made to the *sixth* edition by the author himself, in the epistle to the reader, prefixed to all the subsequent impressions. A copy of the thirteenth edition, printed as early as 1748, is now lying before me. So rapid and so extensive a circulation of a work, on a subject so little within the reach of common readers, is the best proof of the established popularity of the author's name, and of the respect generally entertained for his talents and his opinions.

That the *Essay on Human Understanding* should have excited some alarm in the University of Oxford, was no more than the author had reason to expect from his boldness as a philosophical reformer; from his avowed zeal in the cause of liberty, both civil and religious; from the suspected orthodoxy of his Theological Creed; and (it is but candid to add) from the apparent coincidence of his ethical doctrines with those of Hobbes.[2] It is more difficult to account for the long continuance, in that illustrious seat of learning, of the prejudice against the *logic* of Locke (by far the most valuable part of his work), and of that partiality for the logic of Aristotle, of which Locke has so fully exposed the futility. In the University of Cambridge, on the other hand, the *Essay on Human Understand-*

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[1] See Shaftesbury's First Letter to a Student at the University.

[2] "It was proposed at a meeting of the heads of houses of the University of Oxford, to censure and discourage the reading of Locke's Essay; and, after various debates among themselves, it was concluded, that each head of a house should endeavour to prevent its being read in his college, without coming to any public censure." (See Des Maizeaux's note on a letter from Locke to Collins. Locke's *Works*, Vol. X. p. 284.)

ing was, for many years, regarded with a reverence approaching to idolatry: and to the authority of some distinguished persons connected with that learned body may be traced (as will afterwards appear) the origin of the greater part of the extravagancies which, towards the close of the last century, were grafted on Locke's errors, by the disciples of Hartley, of Law, of Priestley, of Tooke, and of Darwin.[1]

To a person who now reads with attention and candour the work in question, it is much more easy to enter into the prejudices which at first opposed themselves to its complete success, than to conceive how it should so soon have acquired its just celebrity. Something, I suspect, must be ascribed to the political importance which Mr Locke had previously acquired as the champion of religious toleration; as the great apostle of the Revolution; and as the intrepid opposer of a tyranny which had been recently overthrown.

In Scotland, where the liberal constitution of the universities has been always peculiarly favourable to the diffusion of a free and eclectic spirit of inquiry, the philosophy of Locke seems very early to have struck its roots, deeply and permanently, into a kindly and congenial soil. Nor were the errors of this great man implicitly adopted from a blind reverence for his name. The works of Descartes still continue to be studied and admired; and the combined systems of the English and the French metaphysicians served, in many respects, to correct what was faulty, and to supply what was deficient, in either. As to the *ethical* principles of Locke, where they appear to lean towards Hobbism, a powerful antidote against them was already prepared in the Treatise *De Jure Belli et Pacis,* which was then universally and deservedly regarded in this country as the best introduction that had yet appeared to the study of moral science. If Scotland, at [illegible] period, produced no eminent authors in these branches of learning, it was not from want of erudition or of talents; nor yet from the narrowness of mind incident to the inhabitants of remote and insulated regions; but from the almost insuperable difficulty of writing in a dialect, which imposed upon an author the double task of at once acquiring a new language, and of unlearning his own.[2]

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[1] I have taken notice, with due praise, in the former part of this discourse, of the metaphysical speculations of John Smith, Henry More, and Ralph Cudworth; all of them members and ornaments of the university of Cambridge about the middle of the seventeenth century. They were deeply conversant in the Platonic Philosophy, and applied it with great success in combating the Materialists and Necessitarians of their times. They carried, indeed, some of their Platonic notions to an excess bordering on mysticism, and may, perhaps, have contributed to give a bias to some of their academical successors towards the opposite extreme. A very pleasing and interesting account of the characters of these amiable and ingenious men, and of the spirit of their philosophy, is given by Burnet in the *History of his Own Times.*

To the credit of Smith and of More it may be added, that they were among the first in England to perceive and to acknowledge the merits of the Cartesian Metaphysics.

[2] Note (A.)

The success of Locke's Essay, in some parts of the Continent, was equally remarkable; owing, no doubt, in the first instance, to the very accurate translation of it into the French language by Coste, and to the eagerness with which every thing proceeding from the author of the *Letters on Toleration*[1] may be presumed to have been read by the multitude of learned and enlightened refugees, whom the revocation of the edict of Nantz forced to seek an asylum in Protestant countries. In Holland, where Locke was personally known to the most distinguished characters, both literary and political, his work was read and praised by a discerning few, with all the partiality of friendship;[2] but it does not seem to have made its way into the schools till a period considerably later. The doctrines of Descartes, at first so vehemently opposed in that country, were now so completely triumphant, both among philosophers and divines,[3] that it was difficult for a new reformer to obtain a hearing. The case was very nearly similar in Germany, where Leibnitz (who always speaks

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[1] The principle of religious toleration was at that time very imperfectly admitted, even by those philosophers who were the most zealously attached to the cause of civil liberty. The great Scottish lawyer and statesman, Lord Stair (himself no mean philosopher, and, like Locke, a warm partizan of the Revolution), seems evidently to have regretted the impunity which Spinoza had experienced in Holland, and Hobbes in England. "Execrabilis ille Atheus Spinosa adeo impudens est, ut affirmet omnia esse absolute necessaria, et nihil quod est, fuit, aut erit, aliter fieri potuisse, in quo omnes superiores Atheos excessit, aperte negans omnem Deitatem, nihilque præter potentias naturæ agnoscens.

"Vaninus Deitatem non aperte negavit, sed causam illius prodidit, in tractatu quem edidit, argumenta pro Dei existentiâ tanquam futilia et vana rejiciens, adferendo contrarias omnes rationes per modum objectionum, easque prosequendo ut indissolubiles videantur; postea tamen larvam exuit, et atheismum clare professus est, ET JUSTISSIME IN INCLYTA URBE THOLOSA DAMNATUS EST ET CREMATUS.

"Horrendus Hobbesius tertius erat atheismi promotor, qui omnia principia moralia et politica subvertit, eorumque loco naturalem vim et humana pacta, ut prima principia moralitatis, societatis, et politici regiminis substituit: NEC TAMEN SPINOSA AUT HOBBIUS, QUAMVIS IN REGIONIBUS REFORMATIS VIXERINT ET MORTUI SINT, NEDUM EXEMPLA FACTI SUNT IN ATHEORUM TERROREM, UT NE VEL ULLAM PŒNAM SENSERINT."—*Physiol. Nova Experimentalis* (Lugd. Batav. 1686), pp. 16, 17.

[2] Among those whose society Locke chiefly cultivated while in Holland, was the celebrated Le Clerc, the author of the *Bibliothèque Universelle*, and the *Bibliothèque Choisie*, besides many other learned and ingenious publications. He appears to have been warmly attached to Locke, and embraced the fundamental doctrines of his Essay without any slavish deference for his authority. Though he fixed his residence at Amsterdam, where he taught Philosophy and the Belles Lettres, he was a native of Geneva, where he also received his academical education. He is, therefore, to be numbered with Locke's *Swiss* disciples. I shall have occasion to speak of him more at length afterwards, when I come to mention his controversy with Bayle. At present, I shall only observe, that his Eloge on Locke was published in the *Bibliothèque Choisie* (Année 1705), Tom VI.; and that some important remarks on the *Essay on Human Understanding* (particularly on the chapter on Power) are to be found in the 12th Vol. of the same work (Année 1707).

[3] Quamvis huic sectæ (Cartesianæ) initio acriter se opponerent Theologi et Philosophi Belgæ, in Academiis tamen eorum *hodie* (1727), vix alia, quam Cartesiana principia inculcantur. (Heineccii *Elem. Hist. Philosoph.*) In Gravesande's *Introductio ad Philosophiam*, published in 1736, the name of Locke is not once mentioned. It is probable that this last author was partly influenced by his admiration for Leibnitz, whom he servilely followed even in his *physical* errors.

coldly of Locke's Essay)[1] was then looked up to as the great oracle in every branch of learning and of science. If I am not mistaken, it was in Switzerland, where (as Gibbon observes) "the intermixture of sects had rendered the clergy acute and learned on controversial topics," that Locke's real merits were first appreciated on the Continent with a discriminating impartiality. In Crousaz's Treatise of Logic (a book which, if not distinguished by originality of genius, is at least strongly marked with the sound and unprejudiced judgment of the author), we everywhere trace the influence of Locke's doctrines; and, at the same time, the effects of the Cartesian Metaphysics, in limiting those hasty expressions of Locke, which have been so often misinterpreted by his followers.[2] Nor do

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[1] In Lockio sunt quædam particularia non male exposita, sed in summâ longe aberravit à januâ nec naturam mentis veritatisque intellexit.—Leibnitz. Op. Tom. V. p. 355. Ed. Dutens.

M. Locke avoit de la subtilité et de l'addresse, et quelque espèce de métaphysique superficielle qu'il savoit relever. (*Ibid.* pp. 11, 12.)

Heineccius, a native of Saxony, in a Sketch of the History of Philosophy, printed in 1728, omits altogether the name of Locke in his enumeration of the logical and metaphysical writers of modern Europe. In a passage of his logic, where the same author treats of *clear* and *obscure, adequate and inadequate ideas* (a subject on which little or nothing of any value had been advanced before Locke), he observes, in a note, "Debemus hanc Doctrinam Leibnitio, eamque deinde sequutus est illust. Wolfius."

[2] Of the *Essay on Human Understanding* Crousaz speaks in the following terms: "Clarissimi, et merito celebratissimi Lockii de Intellectu Humano eximium opus, et auctore suo dignissimum, *logicis* utilissimis semper annumerabitur." (Præfat.) If Pope had ever looked into this Treatise, he could not have committed so gross a mistake, as to introduce the author into the Dunciad, among Locke's Aristotelian opponents; a distinction for which Crousaz was probably indebted to his acute strictures on those passages in *the Essay on Man*, which seem favourable to fatalism.

> Prompt at the call, around the goddess roll
> Broad hats, and hoods, and caps, a sable shoal;
> Thick and more thick the black blockade extends,
> A hundred head of Aristotle's friends.
> Nor wer't thou, Isis! wanting to the day,
> (Though Christ-church long kept prudishly away).
> Each Staunch Polemic, stubborn as a rock,
> Each fierce Logician, still expelling Locke,
> Come whip and spur, and dash'd through thin and thick
> On German Crousaz, and Dutch Burgersdyck.

Warburton, with his usual scurrility towards all Pope's adversaries as well as his own, has called Crousaz *a blundering Swiss*; but a very different estimate of his merits has been formed by Gibbon, who seems to have studied his works much more carefully than the Right Reverend Commentator on the Dunciad.

"M. de Crousaz, the adversary of Bayle and Pope, is not distinguished by lively fancy or profound reflection; and even in his own country, at the end of a few years, his name and writings are almost obliterated. But his Philosophy had been formed in the school of Locke, his Divinity in that of Limborch and Le Clerc; in a long and laborious life, several generations of pupils were taught to think, and even to write; his lessons rescued the Academy of Lausanne from Calvinistic prejudices; and he had the rare merit of diffusing a more liberal spirit among the people of the *pays de Vaud*." (Gibbon's *Memoirs.*)

Crousaz's academical labours appear to have been less useful than his writings; if a judgment on this point may be formed from the sound philosophical principles which he diffused among a numerous race of pupils. One of these (M. Allamand), the friend and correspondent of Gibbon, deserves particularly to be noticed here, on account of two letters published in the posthumous works of that historian, containing a criticism on Locke's argument against innate ideas, so very able and judicious, that it may still be read with advantage by many logicians of no small note in the learned world. Had these letters happened to have sooner attracted my attention, I should not have delayed so long to do this tardy justice to their merits.[1]

I am not able to speak with confidence of the period at which Locke's Essay began to attract public notice in France. Voltaire, in a letter to Horace Walpole, asserts, that he

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In a subsequent passage Gibbon says, "The logic of Crousaz had prepared me to engage with his master Locke, and his antagonist Bayle; of whom the former may be used as a bridle, and the latter applied as a spur to the curiosity of a young philosopher. *(Ibid.)*

The following details (independently of their reference to Crousaz) are so interesting in themselves, and afford so strong a testimony to the utility of logical studies, when rationally conducted, that I am tempted to transcribe them.

"December 1755. In finishing this year, I must remark how favourable it was to my studies. In the space of eight months, I learned the principles of drawing; made myself completely master of the French and Latin languages, with which I was very superficially acquainted before, and wrote and translated a great deal in both; read Cicero's Epistles ad Familiares, his Brutus, all his Orations, his Dialogues de Amicitia et de Senectute; Terence twice, and Pliny's Epistles. In French, Giannoni's History of Naples, l'Abbé Banier's Mythology, and M. Rochat's Mémoires sur la Suisse, and wrote a very ample relation of my tour. I likewise began to study Greek, and went through the grammar. I began to make very large collections of what I read. But what I esteem most of all,—from the perusal and meditation of De Crousaz's logic, I not only understood the principles of that science, but formed my mind to a habit of thinking and reasoning, I had no idea of before."

After all, I very readily grant, that Crousaz's logic is chiefly to be regarded as the work of a sagacious and enlightened compiler; but even this (due allowance being made for the state of philosophy when it appeared) is no mean praise. "Good sense (as Gibbon has very truly observed) is a quality of mind hardly less rare than genius."

[1] For some remarks of M. Allamand, which approach very near to Reid's Objections to the Ideal Theory, See Note (B.)

Of this extraordinary man Gibbon gives the following account in his *Journal:* "C'est un ministre dans le Pays de Vaud, et un des plus beaux génies que je connoisse. Il a voulu embrasser tous les genres; mais c'est la Philosophie qu'il a le plus approfondi. Sur toutes les questions il s'est fait des systêmes, ou du moins des argumens toujours originaux et toujours ingénieux. Ses idées sont fines et lumineuses, son expression heureuse et facile. On lui reproche avec raison trop de rafinement et de subtilité dans l'esprit; trop de fierté, trop d'ambition, et trop de violence dans le caractère. Cet homme, qui auroit pu éclairer ou troubler une nation, vit et mourra dans l'obscurité."

It is of the same person that Gibbon sneeringly says (in the words of Vossius), "*Est sacrificulus in pago, et rusticos decipit.*"

was the first person who made the name of Locke known to his countrymen;[1] but I suspect that this assertion must be received with considerable qualifications. The striking coincidence between some of Locke's most celebrated doctrines and those of Gassendi, can scarcely be supposed to have been altogether overlooked by the followers and admirers of the latter; considering the immediate and very general circulation given on the Continent to the *Essay on Human Understanding*, by Coste's French version. The *Gassendists*, too, it must be remembered, formed, even before the death of their master, a party formidable in talents as well as in numbers; including, among other distinguished names, those of Moliere,[2] Chapelle,[3] and Bernier;[4] all of them eminently calculated to give the tone, on dis-

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[1] "Je peux vous assurer qu'avant moi personne en France ne connoissoit la poesie Angloise; à peine avoit on entendu parler de Locke. J'ai été persecuté pendant trente ans par une nuée de fanatiques pour avoir dit que Locke est l'Hercule de la Métaphysique, qui a posé les bornes de l'Esprit Humain." (Ferney, 1768.)

In the following passage of *the Age of Louis XIV.* the same celebrated writer is so lavish and undistinguishing in his praise of Locke, as almost to justify a doubt whether he had ever read the book which he extols so highly. "Locke seul a développé *l'entendement humain*, dans un livre ou il n'y a que des vérités; et ce qui rend l'ouvrage parfait, toutes ces vérités sont claires."

[2] Moliere was in his youth so strongly attached to the Epicurean theories, that he had projected a translation of Lucretius into French. He is even said to have made some progress in executing his design, when a trifling accident determined him, in a moment of ill humour, to throw his manuscript into the fire. The plan on which he was to proceed in this bold undertaking does honour to his good sense and good taste, and seems to me the only one on which a successful version of Lucretius can ever be executed. The didactic passages of the poem were to be translated into prose, and the descriptive passages into verse. Both parts would have gained greatly by this compromise; for, where Lucretius wishes to unfold the philosophy of his master, he is not less admirable for the perspicuity and precision of his expressions, than he is on other occasions, where his object is to detain and delight the imaginations of his readers, for the charms of his figurative diction, and for the bold relief of his images. In instances of the former kind, no modern language can give even the *semblance* of poetry to the theories of Epicurus; while, at the same time, in the vain attempt to conquer this difficulty, the rigorous precision and simplicity of the original are inevitably lost.

The influence of Gassendi's instructions may be traced in several of Moliere's comedies; particularly in the *Femmes Savantes*, and in a little piece *Le Mariage Forcé*, where an Aristotelian and a Cartesian doctor are both held up to the same sort of ridicule, which, in some other of his performances, he has so lavishly bestowed on the medical professors of his time.

[3] The joint author, with Bachaumont, of the *Voyage en Provence*, which is still regarded as the most perfect model of that light, easy, and graceful *badinage* which seems to belong exclusively to French poetry. Gassendi who was an intimate friend of his father, was so charmed with his vivacity while a boy, that he condescended to be his instructor in philosophy; admitting, at the same time, to his lessons, two other illustrious pupils, Moliere and Bernier. The life of Chapelle, according to all his biographers, exhibited a complete contrast to the simple and ascetic manners of his master; but, if the following account is to be credited, he missed no opportunity of propagating, as widely as he could, the speculative principles in which he had been educated. "Il étoit fort éloquent dans l'ivresse. Il restoit ordinairement le dernier à table, et se mettoit à expliquer aux valets la philosophie d'Epicure." (*Biographie Universelle*, article *Chapelle*, Paris, 1813.) He died in 1686.

[4] The well known author of one of our most interesting and instructive books of travels. After his re-

puted questions of Metaphysics, to that numerous class of Parisians of both sexes, with whom the practical lessons, vulgarly imputed to Epicurus, were not likely to operate to the prejudice of his speculative principles. Of the three persons just mentioned, the two last died only a few years before Locke's *Essay* was published; and may be presumed to have left behind them many younger pupils of the same school. One thing is certain, that, long before the middle of the last century, the *Essay on Human Understanding* was not only read by the learned, but had made its way into the circles of fashion at Paris.[1] In what manner this is to been accounted for, it is not easy to say; but the fact will not be disputed by those who are at all acquainted with the history of French literature.

In consequence of this rapid and extensive circulation of the work in question, and the strong impression that it every where produced, by the new and striking contrast which it exhibited to the doctrines of the schools, a very remarkable change soon manifested itself in the prevailing habits of thinking on philosophical subjects. Not that it is to be supposed that the opinions of men, on particular articles of their former creed, underwent a sudden alteration. I speak only of the *general effect* of Locke's discussions, in preparing the thinking part of his readers, to a degree till then unknown, for the unshackled use of their own reason. This has always appeared to me the most characteristical feature of Locke's Essay: and *that* to which it is chiefly indebted for its immense influence on the philosophy of the eighteenth century. Few books can be named, from which it is possible to extract more exceptionable passages; but, such is the liberal tone of the author; such the manliness with which he constantly appeals to *reason*, as the paramount authority which, even in religious controversy, every candid disputant is bound to acknowledge; and such the sincerity and simplicity with which, on all occasions, he appears to inquire after truth,

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turn from the East, where he resided twelve years at the court of the Great Mogul, he published, at Lyons, an excellent *Abridgment of the Philosophy of Gassendi*, in 8 vols. 12mo; a second edition of which, corrected by himself, afterwards appeared, in seven volumes. To this second edition (which I have never met with) is annexed a Supplement, entitled *Doutes de M. Bernier sur quelques uns des principaux Chapitres de son Abrégé de la Philosophie de Gassendi.* It is to this work, I presume, that Leibnitz alludes in the following passage of a letter to John Bernouilli; and, from the manner in which he speaks of its contents it would seem to be an object of some curiosity. "Frustra quæsivi apud typographos librum cui titulus; *Doutes de M. Bernier sur la Philosophie,* in Gallia ante annos aliquot editum et mihi visum, sed nunc non repertum. Vellem autem idêo iterum legere, quia ille *Gassendistorum* fuit Princeps; sed paullo ante mortem, libello hoc edito ingenue professus est, in quibus nec Gassendus nec Cartesius satisfaciant." (Leibnitii et Jo. Bernouilli *Commerc. Epist.* 2 vol. 4to. Laussanæ et Genevæ, 1745.)

Bernier died in 1688.

[1] A decisive proof of this is afforded by the allusions to Locke's doctrines in the dramatic pieces then in possession of the French stage. See Note (C.)

that the *general effect* of the whole work may be regarded as the best of all antidotes against the errors involved in some of its particular conclusions.[1]

To attempt any general review of the doctrines sanctioned, or supposed to be sanctioned, by the name of Locke, would be obviously incompatible with the design of this Discourse; but, among these doctrines, there are *two* of fundamental importance, which have misled so many of his successors, that a few remarks on each form a necessary preparation for some historical details which will afterwards occur. The first of these doctrines relates to the ORIGIN OF OUR IDEAS; the second to THE POWER OF MORAL PERCEPTION, AND THE IMMUTABILITY OF MORAL DISTINCTIONS. On *both* questions, the real opinion of Locke has, if I am not widely mistaken, been very grossly misapprehended or misrepresented, by a large portion of his professed followers, as well as of his avowed antagonists.

I. The objection to which Locke's doctrine concerning the origin of our ideas, or, in other words, concerning the sources of our knowledge, are, in my judgment, liable, I have stated so fully in a former work,[2] that I shall not touch on them here. It is quite sufficient, on the present occasion, to remark, how very unjustly *this* doctrinee (imperfect, on the most favourable construction, as it undoubtedly is) has been confounded with those of Gassendi, of Condillac, of Diderot, and of Horne Tooke. The substance of all that is common in the conclusions of these last writers, cannot be better expressed than in the words of their master Gassendi. "All our knowledge (he observes in a letter to Descartes) appears plainly to derive its origin from the senses; and although you deny the maxim, 'Quicquid est in intellectu præesse debere in sensu,' yet this maxim appears, nevertheless, to be true; since our knowledge is all ultimately obtained by an *influx* or *incursion* from things external; which knowledge afterwards undergoes various modifications by means of analogy, composition, division, amplification, extenuation, and other similar processes, which it is unnecessary to enumerate."[3]

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[1] The maxim which he constantly inculcates is, that "Reason must be our last judge and guide in every thing." (Locke's *Works*, Vol. III. p. 145.) To the same purpose, he elsewhere observes, that, "he who makes use of the light and faculties God has given him, and seeks sincerely to discover truth by those helps and abilities he has, may have this satisfaction in doing his duty as a rational creature; that, though he should miss truth, he will not miss the reward of it. For *he* governs his assent right, and places it as he should, who in any case or matter whatsoever, believes or disbelieves, according as reason directs him. He that does otherwise, transgresses against his own light, and misuses those faculties which were given him to no other end, but to search and follow the clearer evidence and greater probability." (*Ibid.* p. 125.)

[2] *Philosophical Essays.*

[3] "Deinde omnis nostra notitia videtur plane ducere originem à sensibus; et quamvis tu neges quicquid est in intellectu præesse debere in sensu, videtur id esse nihilominus verum, cum nisi solâ incursione

This doctrine of Gassendi's coincides exactly with that ascribed to Locke by Diderot and by Horne Tooke; and it differs only verbally from the more concise statement of

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Κατα περιπτωσιν, ut loquuntur, fiat; perficiatur tamen analogia, compositione, divisione, ampliatione, extenuatione, aliisque similibus modis, quos commemorare nihil est necesse." (*Objectiones in Meditationem Secundam.*)

This doctrine of Gassendi's is thus very clearly stated and illustrated, by the judicious authors of the *Port Royal Logic*. " Un philosophe qui est estimé dans le monde commence sa logique par cette proposition: *Omnis idea orsum ducit a sensibus. Toute idée tire son origine des sens.* Il avoue néanmoins que toutes nos idées n'ont pas été dans nos sens telles qu'elles sont dans notre esprit: mais il prétend qu'elles ont au moins été formées de celles qui ont passé par nos sens, ou par *composition*, comme lorsque des images separées de l'or et d'une montagne, on s'en fait une montagne d'or; ou par *ampliation* et *diminution*, comme lorsque de l'image d'un homme d'une grandeur ordinaire on s'en forme un géant ou un pigmée; ou par *accommodation* et *proportion*, comme lorsque de l'idée d'une maison qu'on a vue, on s'en forme l'image d'une maison qu'on n'a pas vue. ET AINSI, dit il, NOUS CONCEVONS DIEU QUI NE PEUT TOMBER SOUS LES SENS, SOUS L'IMAGE D'UN VENERABLE VIEILLARD." " Selon cette pensée quoique toutes nos idées ne fussent semblables à quelque corps particulier que nous ayons vu, ou qui ait frappé nos sens, elles seroient néanmoins toutes corporelles, et ne vous representeroient rien qui ne fût entré dans nos sens, au moins par parties. Et ainsi nous ne concevons rien que par des images, semblables à celles qui se forment dans les cerveau quand nous voyons, ou nous nous imaginons des corps." (*L'Art de Penser*, 1. Partie. c. 1.)

The reference made, in the foregoing quotation, to Gassendi's illustration drawn from *the idea of God*, affords me an opportunity, of which I gladly avail myself, to contrast it with Locke's opinion on the same subject. " How many amongst us will be found, upon inquiry, to fancy God, in the shape of a man, sitting in heaven, and to have many other absurd and unfit conceptions of him? Christians, as well as Turks, have had whole sects owning, or contending earnestly for it, that the Deity was corporeal and of human shape: And although we find few amongst us, who profess themselves *Anthropomorphites* (though some I have met with that own it), yet, I believe, he that will make it his business, may find amongst the ignorant and uninstructed Christians, many of that opinion."* (Vol. I. p. 67.)

" Let the ideas of being and matter be strongly joined either by education or much thought, whilst these are still combined in the mind, what notions, what reasonings will there be about separate spirits? Let custom, from the very childhood, have joined figure and shape to the idea of God, and what absurdities will that mind be liable to about the Deity?" (Vol. II. p. 144.)

The authors of the *Port Royal Logic* have expressed themselves on this point to the very same purpose with Locke; and have enlarged upon it still more fully and forcibly. (See the sequel of the passage above quoted.) Some of their remarks on the subject, which are more particularly directed against Gassendi, have led Brucker to rank them among the advocates for *innate ideas* (Brucker, *Historia de Ideis*, p. 271), although these remarks coincide exactly in substance with the foregoing quotation from Locke. Like many other modern metaphysicians, this learned and laborious, but not very acute historian, could imagine no intermediate opinion between the theory of *innate ideas*, as taught by the Cartesians, and the Epicurean account of our knowledge, as revived by Gassendi and Hobbes; and accordingly thought himself entitled to conclude, that whoever rejected the one

* In the judgment of a very learned and pious divine, the bias towards *Anthropomorphism*, which Mr. Locke has here so severely reprehended, is not confined to " ignorant and uninstructed Christians. " If *Anthropomorphism* (says Dr Maclaine) was banished from theology, orthodoxy would be deprived of some of its most precious phrases, and our confessions of faith and systems of doctrine would be reduced within much narrower bounds."—(Note on Mosheim's *Church History*, Vol. IV. p. 550.)

In Bernier's *Abridgment of Gassendi's Philosophy* (Tom. III. p. 13, *et seq.*), an attempt is made to reconcile with the Epicurean account of the origin of our knowledge, that more pure and exalted idea of GOD to which the mind is gradually led by the exercise of its reasoning powers: But I am very doubtful, if Gassendi would have subscribed, in this instance, to the comments of his ingenious disciple. (See pp. 109, 110, of the first part of this Dissertation.)

Condillac, that "our ideas are nothing more than *transformed* sensations." "Every idea," says the first of these writers, "must necessarily, when brought to its state of ultimate decomposition, resolve itself into a *sensible* representation or picture; and since every thing *in* our understanding has been introduced there by the channel of sensation, whatever proceeds *out* of the understanding is either chimerical, or must be able, in returning by the same road, to reattach itself to its sensible archetype. Hence an important rule in philosophy,—that every expression which cannot find an external and a sensible object, to which it can thus establish its affinity, is destitute of signification." (*Oeuvres de* Diderot, Tom. VI.)

Such is the exposition given by Diderot, of what is regarded in France, as Locke's great and capital *discovery;* and precisely to the same purpose we are told by Condorcet, that "Locke was the first who proved that *all our ideas are compounded of sensations.*" (*Esquisse Historique*, &c.)

If this were to be admitted as a fair account of Locke's opinion, it would follow, that he has not advanced a single step beyond Gassendi and Hobbes; both of whom have repeatedly expressed themselves in nearly the same words with Diderot and Condorcet. But al-

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must necessarily have adopted the other. The doctrines of Locke and of his predecessor Arnauld will be found, on examination, essentially different from both.

Persons little acquainted with the metaphysical speculations of the two last centuries are apt to imagine, that when "all knowledge is said to have its origin in the senses," nothing more is to be understood than this, that it is by the impressions of external objects on our organs of perception, that *the dormant powers* of the understanding are at first awakened. The foregoing quotation from Gassendi, together with those which I am about to produce from Diderot and Condorcet, may, I trust, be useful in correcting this very common mistake; all of these quotations explicitly asserting, that the external senses furnish not only the *occasions* by which our intellectual powers are excited and developed, but all the *materials* about which our thoughts are conversant; or, in other words, that it is impossible for us to think of any thing, which is not either a sensible image, or the result of sensible images combined together, and transmuted into new forms by a sort of logical chemistry. That the powers of the understanding would for ever continue dormant, were it not for the action of things external on the bodily frame, is a proposition now universally admitted by philosophers. Even Mr Harris and Lord Monboddo, the two most zealous, as well as most learned, of Mr Locke's adversaries in England, have, in the most explicit manner, expressed their assent to the common doctrine. "The first class of ideas (says Monboddo) is produced from ideas furnished by the senses; the second arises from the operations of the mind upon these materials: for I do not deny, that in this our present state of existence, all our ideas, and all our knowledge, are ultimately to be derived from sense and matter." (Vol. I. p. 44. 2d Ed.) Mr. Harris, while he holds the same language, points out, with greater precision, the essential difference between his philosophy and that of the Hobbists. "Though sensible objects may be the destined medium to awaken the dormant energies of man's understanding, yet are those energies themselves no more contained in sense, than the explosion of a cannon in the spark which gave it fire." (Hermes.) (On this subject see *Elements of the Philosophy of the Human Mind*, Vol. I. chap. i. sect. 4.)

To this doctrine I have little doubt that Descartes himself would have assented, although the contrary opinion has been generally supposed by his adversaries to be virtually involved in his *Theory of Innate Ideas.* My reason for thinking so, the reader will find stated in Note (D.)

though it must be granted, in favour of their interpretation of his language, that various detached passages may be quoted from his work, which seem, on a superficial view, to justify their comments, yet of what weight, it may be asked, are these passages, when compared with the stress laid by the author on *Reflection*, as an original source of our ideas, altogether different from *Sensation?* "The *other fountain*," says Locke, "from which experience furnisheth the understanding with ideas, is the perception of the operations of our own minds within us, as it is employed about the ideas it has got; which operations, when the soul comes to *reflect on* and consider, do furnish the understanding with another set of ideas, which could not be had from things without; and such are *Perception, Thinking, Doubting, Believing, Reasoning, Knowing, Willing*, and all the different actings of our own minds, which, we being conscious of, and observing in ourselves, do from these receive into our understandings ideas as distinct as we do from bodies affecting our senses. This source of ideas every man has wholly in himself: And though it be not sense, *as having nothing to do with external objects*, yet it is very like it, and might properly enough be called *internal sense*. But as I call the other SENSATION, so I call this REFLECTION; the ideas it affords being such only as the mind gets by *reflecting* on its own operations within itself."[1] (Locke's *Works*, Vol. I. p. 78.)

"The understanding seems to me not to have the least glimmering of any ideas which it doth not receive from one of these two. *External objects furnish the mind with the ideas of sensible qualities; and the mind furnishes the understanding with ideas of its own operations.*" (*Ibid.* p. 79.)

In another part of the same chapter, Locke expresses himself thus: "Men come to be furnished with fewer or more simple ideas from without, according as the objects they converse with afford greater or less variety; and from the operations of their minds within, according as they more or less REFLECT on them. For, though he that contemplates the operations of his mind, cannot but have plain and clear ideas of them; yet, unless he turn his thoughts that way, and consider them *attentively*, he will no more have clear and distinct ideas of all the operations of his mind, and all that may be observed therein, than he will have all the particular ideas of any landscape, or of the parts and motions of a clock, who will not turn his eyes to it, and with attention heed all the parts of it. The picture, or clock, may be so placed, that they may come in his way every day; but yet he will have but a confused idea of all the parts they are made up of, till he applies himself with attention to consider them in each particular.

[1] Note (E.)

"And hence we see the reason why it is pretty late before most children get ideas of the operations of their own minds; and some have not any very clear or perfect ideas of the greatest part of them all their lives...... Children, when they first come into it, are surrounded with a world of new things, which, by a constant solicitation of their senses, draw the mind constantly to them,—forward to take notice of new, and apt to be delighted with the variety of changing objects. Thus, the first years are usually employed and directed in looking abroad. Men's business in them is to acquaint themselves with what is to be found without; and so growing up in a constant attention to outward sensations, seldom make any considerable reflection on what passes within them, till they come to be of riper years; and some scarce ever at all." (*Ibid.* pp. 80, 81.)

I beg leave to request more particularly the attention of my readers to the following paragraphs:

"If it be demanded, *when a man begins to have any ideas?* I think the true answer is, when he first has any *sensation*.....I conceive that ideas in the understanding are coëval with *sensation;* which is such an impression or motion, made in some part of the body, as produces some perception in the understanding. It is about these impressions made on our senses by outward objects, that the mind seems *first* to employ itself in such operations as we call *Perception, Remembering, Consideration, Reasoning,* &c.

"In time, the mind comes to reflect on its own operations, and about the ideas got by sensation, and thereby stores itself with a new set of ideas, which I call *ideas of reflection.* These impressions that are made on our senses by objects extrinsical to the mind; and *its own operations, proceeding from powers intrinsical and proper to itself* (which, when reflected on by itself, become also objects of its contemplation), are, as I have said, *the original of all knowledge.*"[1] (*Ibid.* pp. 91, 92.)

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[1] The idea attached by Locke in the above passages to the word *Reflection* is clear and precise. But in the course of his subsequent speculations, he does not always rigidly adhere to it, frequently employing it in that more extensive and popular sense in which it denotes the attentive and deliberate consideration of any object of thought, whether relating to the external or to the internal world. It is in this sense he uses it when he refers to Reflection our ideas of Cause and Effect, of Identity and Diversity, and of *all other relations.* "All of these (he observes) *terminate in,* and are *concerned about,* those simple ideas, either of Sensation or Reflection, which I think to be the whole materials of all our knowledge." (Book II. c. xxv. sect. 9.) From this explanation it would appear that Locke conceived it sufficient to justify his account of the origin of our knowledge, if it could be shown that all our ideas *terminate in, and are concerned about,* ideas derived either from Sensation or Reflection, according to which comment it will not be a difficult task to obviate every objection to which his fundamental principle concerning the two sources of our ideas may appear to be liable.

In this lax interpretation of a principle so completely interwoven with the whole of his philosophy, there is undoubtedly a departure from logical accuracy; and the same remark may be extended to the vague

A few other scattered sentences, collected from different parts of Locke's *Essay*, may throw additional light on the point in question.

" I know that people, whose thoughts are immersed in matter, and have so subjected their minds to their senses, that they seldom reflect on any thing beyond them, are apt to say, they cannot comprehend a *thinking* thing, which perhaps is true: But I affirm, when they consider it well, they can no more comprehend an *extended* thing.

" If any one say, he knows not what 'tis thinks in him; he means, he knows not what the substance is of that thinking thing: No more, say I, knows he what the substance is of that solid thing. Father, if he says, he knows not *how* he thinks; I answer, Neither knows he *how* he is extended; *how* the solid parts of body are united, or cohere together to make extension." (Vol. II. p. 22.)

" I think we have as many and as clear ideas belonging to mind, as we have belonging to body, the substance of each being equally unknown to us; and the idea of thinking in mind as clear as of extension in body; and the communication of motion by thought which we attribute to mind, is as evident as that by impulse, which we ascribe to body. Constant experience makes us sensible of both of these, though our narrow understandings can comprehend neither.[1]

" To conclude; Sensation convinces us, that there are solid extended substances; and Reflection, that there are thinking ones: Experience assures us of the existence of such beings; and that the one hath a power to move body by impulse, the other by thought; *this* we cannot doubt of. But beyond these ideas, as received from their proper sources, our faculties will not reach. If we would inquire farther into their nature, causes, and

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and indefinite use which he occasionally makes of the word *Reflection;* a word which expresses the peculiar and characteristical doctrine, by which his system is distinguished from that of the Gassendists and Hobbists. All this, however, serves only to prove still more clearly, how widely remote his real opinion on this subject was from that commonly ascribed to him by the French and German commentators. For my own part, I do not think (notwithstanding some casual expressions which may seem to favour the contrary supposition) that Locke would have hesitated for a moment to admit, with Cudworth and Price, that the *Understanding* is itself a source of new ideas. That it is by *Reflection* (which, according to his own definition, means merely the exercise of the *Understanding* on the internal phenomena) that we get our ideas of memory, imagination, reasoning, and of all other intellectual powers, Mr. Locke has again and again told us; and from this principle it is so obvious an inference, that all the simple ideas which are necessarily implied in our intellectual operations, are ultimately to be referred to the same source, that we cannot reasonably suppose a philosopher of Locke's sagacity to admit the former proposition, and to withhold his assent to the latter.

[1] In transcribing this paragraph, I have taken the liberty to substitute the word *Mind* instead of *Spirit*. The two words were plainly considered by Locke, on the present occasion, as quite synonymous; and the latter (which *seems* to involve a theory concerning the nature of the thinking principle) is now almost universally rejected by English metaphysicians from their Philosophical Vocabulary.

manner, we perceive not the nature of Extension clearer than we do of Thinking. If we would explain them any farther, one is as easy as the other; and there is no more difficulty to conceive *how* a substance we know not should by *thought* set body into motion, than how a substance we know not should, by *impulse*, set body into motion." (*Ibid.* pp. 26, 27.)

The passage in Locke which, on a superficial view, appears the most favourable to the misinterpretation put on his account of the Sources of our Knowledge, by so many of his professed followers, is, in my opinion, the following:

" It may also lead us a little towards the original of all our notions and knowledge, if we remark, how great a dependence our words have on common sensible ideas; and how those which are made use of to stand for actions and notions quite removed from sense, have their rise from thence, and from obvious sensible ideas are transferred to more abstruse significations, and made to stand for ideas that come not under the cognizance of our senses; *v. g. to imagine, apprehend, comprehend, adhere, conceive, instil, disgust, disturbance, tranquillity,* &c. are all words taken from the operations of sensible things, and applied to certain modes of thinking. *Spirit,* in its primary signification, is breath; *angel,* a messenger: *and I doubt not, but if we could trace them to their sources, we should find, in all languages, the names which stand for things that fall not under our senses, to have had their first rise from sensible ideas.* By which we may give some kind of guess what kind of notions they were, and whence derived, which filled their minds who were the first beginners of languages; and how nature, even in the naming of things, unawares suggested to men the originals and principles of all their knowledge."

So far the words of Locke coincide very nearly, if not exactly, with the doctrines of Hobbes and of Gassendi; and I have not a doubt, that a mistaken interpretation of the clause which I have distinguished by *italics,* furnished the germ of all the mighty *discoveries* contained in the Επεα πτεροεντα. If Mr Tooke, however, had studied with due attention the import of what immediately follows, he must have instantly perceived how essentially different Locke's real opinion on the subject was from what he conceived it to be.— " Whilst to give names, that might make known to others any operations they felt in themselves, or any other ideas that came not under their senses, they were fain to borrow words from ordinary known ideas of sensation, by that means to make others the more easily to conceive those operations they experienced in themselves, which made no outward sensible appearances; and then, when they had got known and agreed names, to signify those internal operations of their own minds, they were sufficiently furnished to make known by words all their other ideas; since they could consist of nothing but either of

outward sensible perceptions, or of the inward operations of their minds about them." (Vol. II. pp. 147, 148.)

From the sentences last quoted, it is manifest, that when Locke remarked the *material* etymology of all our language about mind, he had not the most distant intention to draw from it any inference which might tend to identify the sensible images which this language presents to the fancy, with the metaphysical notions which it figuratively expresses. Through the whole of his *Essay*, he uniformly represents *sensation* and *reflection* as radically distinct sources of knowledge; and, of consequence, he must have conceived it to be not less unphilosophical to attempt an explanation of the phenomena of mind by the analogy of matter, than to think of explaining the phenomena of matter by the analogy of mind. To this fundamental principle concerning the origin of our ideas, he has added, in the passage now before us, That, as our knowledge of mind is posterior in the order of time to that of matter (the first years of our existence being necessarily occupied about objects of sense), it is not surprising, that "when men wished *to give names that might make known to others* any operations they felt in themselves, or any other ideas that came not under their senses, they should have been fain to borrow words from ordinary known ideas of sensation, by that means to make others the more easily to conceive those operations which make no outward sensible appearances." According to this statement, the purpose of these "borrowed" or metaphorical words is not (as Mr Tooke concluded) to *explain* the nature of the operations, but to direct the attention of the hearer to that internal world, the phenomena of which he can only learn to comprehend by the exercise of his own power of reflection. If Locke has nowhere affirmed so explicitly as his predecessor Descartes, that "nothing conceivable by the power of imagination can throw any light on the operations of thought," it may be presumed that he considered this as unnecessary, after having dwelt so much on *reflection* as the exclusive source of all our ideas relating to mind; and on the peculiar difficulties attending the exercise of this power, in consequence of the effect of early associations in confounding together our notions of mind and of matter.

The misapprehensions so prevalent on the Continent, with respect to Locke's doctrine on this most important of all metaphysical questions, began during his own lifetime; and were countenanced by the authority of no less a writer than Leibnitz, who always represents Locke as a partizan of the scholastic maxim, *Nihil est in intellectu quod non fuerit in sensu.*—"Nempe (says Leibnitz in reply to this maxim) nihil est in intellectu quod non fuerit in sensu, *nisi ipse intellectus*."[1] The remark is excellent, and does honour to the

[1] *Opera*, Tom. V. pp. 358, 359.

That the same mistake still keeps its ground among many foreign writers of the highest class, the following

acuteness of the critic; but it is not easy to conceive on what grounds it should have been urged as an objection to a writer, who has insisted so explicitly and so frequently on *re-*

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passage affords a sufficient proof: "Leibnitz a combattu avec une force de dialectique admirable le Systême de Locke, qui attribue toutes nos idées à nos sensations. On avoit mis en avant cet axiome si connu, qu'il n'y avoit rien dans l'intelligence qui n'eut été d'abord dans les sensations, et Leibnitz y ajouta cette sublime restriction, *si ce n'est l'intelligence elle-meme*. De ce principe dérive toute la philosophie nouvelle qui exerce tant d'influence sur les esprits en Allemagne." (*Mad. de Stael de l'Allemagne*, Tom. III. p. 65.)

I observed in the First Part of this Dissertation (page 67), that this *sublime restriction* on which so much stress has been laid by the partizans of the German school, is little more than a translation of the following words of Aristotle: Και αυτος δε νους νοητος εστιν, ὥσπερ τα νοητὰ επι μεν γαρ των ανευ ὕλης, το αυτο εστι το νοουν καὶ το νοουμενον. (*De Anima*, Lib. III. cap. v.)

As to Locke, the same injustice which he received from Leibnitz was very early done to him in his own country. In a tract printed in 1697, by a mathematician of some note, the Author of the *Essay on Human Understanding* is represented as holding the same opinion with Gassendi concerning the origin of our ideas. "*Ideæ* nomine communi sensu utor; earum originem an a sensibus solum, ut Gassendo et Lockio nostrati, cæterisque plurimis visum est, an aliundè, hujus loci non est inquirere." (*De Spatio Reali, seu Ente Infinito Conamen Mathematico-Metaphysicum*. Auctore Josepho Raphson, Reg. Soc. Socio. This tract is annexed to the second edition of a work entitled *Analysis Æquationum Universalis*. Lond. 1702.)

In order to enable my readers more easily to form a judgment on the argument in the text, I must beg leave once more to remind them of the distinction already pointed out between the Gassendists and the Cartesians; the former asserting, that, as all our ideas are derived from the external senses, the intellectual phenomena can admit of no other explanation than what is furnished by analogies drawn from the material world; the latter rejecting these analogies altogether, as delusive, and treacherous lights in the study of mind; and contending, that the exercise of the power of reflection is the only medium through which any knowledge of its operations is to be obtained. To the one or the other of these two classes, all the metaphysicians of the last century may be referred; and even at the present day, the fundamental question which formed the chief ground of controversy between Gassendi and Descartes (I mean the question concerning the proper logical method of studying the mind) still continues the hinge on which the most important disputes relating to the internal world will be found ultimately to turn.

According to this distinction, Locke (notwithstanding some occasional slips of his pen) belongs indisputably to the class of Cartesians; as well as the very small number of his followers who have entered thoroughly into the spirit of his philosophy. To the class of Gassendists, on the other hand, belong all those French metaphysicians, who, professing to tread in Locke's footsteps, have derived all their knowledge of the *Essay on Human Understanding* from the works of Condillac; together with most of the commentators on Locke who have proceeded from the school of Bishop Law. To these may be added (among the writers of later times) Priestley, Darwin, Beddoes, and, above all, Horne Tooke, with his numerous disciples.

The doctrine of Hobbes on this cardinal question coincided entirely with that of Gassendi, and, accordingly, it is not unusual in the present times, among Hobbes's disciples, to ascribe to him the whole merit of that account of the origin of our knowledge, which, from a strange misconception, has been supposed to have been claimed by Locke as his own discovery. But where, it may be asked, has Hobbes said anything about the origin of those ideas which Locke refers to the power of *reflection*? and may not the numerous observations which Locke has made on *this* power as a source of ideas peculiar to itself, be regarded as an indirect refutation of that theory which would resolve all the objects of our knowledge into *sensa-*

flection as the source of a class of ideas essentially different from those which are derived from *sensation*. To myself it appears, that the words of Leibnitz only convey, in a more concise and epigrammatic form, the substance of Locke's doctrine. Is any thing implied in them which Locke has not more fully and clearly stated in the following sentence?

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tions, as their ultimate elements? This was not merely a step *beyond* Hobbes; but the correction of an error which lies at the very root of Hobbes's system;—an error, under which (it may be added) the greater part of Hobbes's eulogists have the misfortune still to labour.

It is with much regret I add, that a very large proportion of the English writers, who call themselves *Lockists*, and who, I have no doubt, believe themselves to be so in reality, are at bottom (at least in their metaphysical opinions) *Gassendists* or *Hobbists*. In what respect do the following observations differ from the Epicurean theory concerning the origin of our knowledge, as expounded by Gassendi? "The ideas conveyed by sight, and by our other senses, having entered the mind, intermingle, unite, separate, throw themselves into various combinations and postures, and thereby generate new ideas of reflection, strictly so called; such as those of comparing, dividing, distinguishing,—of abstraction, relation, with many others; all which remain with us as stock for our further use on future occasions." I do not recollect any passage, either in Helvetius or Diderot, which contains a more explicit and decided avowal of that Epicurean system of Metaphysics, which it was the great aim both of Descartes and of Locke to overthrow.

In the following conjectures concerning the *nature* of our ideas, the same author has far exceeded in extravagance any of the Metaphysicians of the French school. "What those *substances* are, whereof our ideas are the modifications, *whether parts of the mind as the members are of our body, or contained in it like wafers in a box, or enveloped by it like fish in water*, whether *of a spiritual, corporeal, or middle nature between both*, I need not now ascertain. All I mean to lay down at present is this, that, in every exercise of the understanding, that which discerns is *numerically and substantially distinct* from that which is discerned; and that an act of the understanding is not so much our own proper act, as the act of something else operating upon us."

I should scarcely have thought it worth while to take notice of these passages, had not the doctrines contained in the work from which they were taken, been sanctioned in the most unqualified terms by the high authority of Dr Paley. "There is one work (he observes) to which I owe so much, that it would be ungrateful not to confess the obligation: I mean the writings of the late Abraham Tucker, Esq. part of which were published by himself, and the remainder since his death, under the title of the *Light of Nature Pursued*, by Edward Search, Esq." "*I have found, in this writer, more original thinking and observation upon the several subjects that he had taken in hand, than in any other, not to say than in all others put together.* His talent also for illustration is unrivalled. But his thoughts are diffused through a long, various, and irregular work. I shall account it no mean praise, if I have been sometimes able to dispose into method, to collect into heads and articles, or to exhibit in more compact and tangible masses, what, in that excellent performance, is spread over too much surface." (*Principles of Moral and Political Philosophy*, Preface, pp. 25, 26.)

Of an author whom Dr Paley has honoured with so very warm an eulogy, it would be equally absurd and presumptuous to dispute the merits. Nor have I any wish to detract from the praise here bestowed on him as an original thinker and observer. I readily admit, also, his talent for illustration, although it sometimes leads him to soar into bombast, and more frequently to sink into buffoonery. As an honest inquirer after moral and religious truth, he is entitled to the most unqualified approbation. But, I must be permitted to add, that, as a metaphysician, he seems to me much more fanciful than solid; and, at the same time, to be so rambling, verbose, and excursive, as to be more likely to unsettle than to fix the principles of his reader.

"External objects furnish the mind with the ideas of sensible qualities; and the mind furnishes the understanding with ideas of its own operations." (Locke's *Works*, Vol. I. p. 79.)

The extraordinary zeal displayed by Locke, at the very outset of his work, against the hypothesis *of innate ideas*, goes far to account for the mistakes committed by his commentators, in interpreting his account of the origin of our knowledge. It ought, however, to be always kept in view, in reading his argument on the subject, that it is the *Cartesian* theory of innate ideas which he is here combating; according to which theory (as understood by Locke), an *innate idea* signifies *something* coëval in its existence with the mind to which it belongs, and illuminating the understanding before the external senses begin to operate. The very close affinity between this theory, and some of the doctrines of the Platonic school, prevented Leibnitz, it is probable, from judging of Locke's argument against it, with his usual candour; and disposed him hastily to conclude, that the opposition of Locke to Descartes proceeded from views essentially the same with those of Gassendi, and of his other Epicurean antagonists. How very widely he was mistaken in this conclusion, the numerous passages which I have quoted in Locke's own words sufficiently demonstrate.

In what respects Locke's account of the origin of our ideas *falls short* of the truth, will appear, when the metaphysical discussions of later times come under our review. Enough has been already said to show, how completely this account has been misapprehended, not only by his opponents, but by the most devoted of his admirers;—a misapprehension so very general, and, at the same time, so obviously at variance with the whole spirit of his Essay, as to prove to a demonstration that, in point of numbers, the *intelligent readers* of this celebrated work have hitherto borne but a small proportion to its purchasers and panegyrists. What an illustration of the folly of trusting, in matters of literary history, to the traditionary judgments copied by one commentator, or critic from another, when recourse may so easily be had to the original sources of information![1]

[1] In justice to Dr Hartley, I must here observe, that, although his account of the origin of our ideas is precisely the same with that of Gassendi, Hobbes, and Condillac (one of his fundamental principles being, that the *ideas* of sensation are the *elements* of which all the rest are compounded),* he has not availed himself, like the other Gassendists of later times, of the name of Locke to recommend this theory to the favour of his readers. On the contrary, he has very clearly and candidly pointed out the wide and essential distinction between the two opinions. "It may not be amiss here to take notice how far the theory of these papers has led me to differ, in respect of logic, from Mr Locke's excellent *Essay on the Human Understanding*,

* Hartley on Man, 4th Ed. p. 2 of the Introduction.

II. Another misapprehension, not less prevalent than the former, with respect to Locke's philosophical creed, relates to the power of moral perception, and the immutabili-

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to which the world is so much indebted for removing prejudices and encumbrances, and advancing real and useful knowledge.

"First, then, it appears to me, that all the most complex ideas arise from sensation, and that *reflection is not a distinct source*, as Mr Locke makes it."*

This last proposition Hartley seems to have considered as an important and original improvement of his own on Locke's logic; whereas, in fact, it is a relapse into the old Epicurean hypothesis, which it was one of the main objects of Locke's Essay to explode.

I would not have enlarged so fully on Locke's account of the origin of our ideas, had not a mistaken view of his argument on this head, served as a ground-work for the whole Metaphysical Philosophy of the French *Encyclopédie*. That all our knowledge is derived from our external senses, is everywhere assumed by the conductors of that work as a demonstrated principle; and the credit of this demonstration is uniformly ascribed to Locke, who, we are told, was the first that fully unfolded and established a truth of which his predecessors had only an imperfect glimpse. La Harpe, in his *Lycée*, has, on this account, justly censured the metaphysical phraseology of the *Encyclopédie*, as tending to degrade the intellectual nature of man; while, with a strange inconsistency, he bestows the most unqualified praise on the writings of Condillac. Little did he suspect, when he wrote the following sentences, how much the reasonings of his favourite logician had contributed to pave the way for those conclusions which he reprobates with so much asperity in Diderot and D'Alembert.

"La gloire de Condillac est d'avoir été le premier disciple de Locke; mais si Condillac eut un maître, il mérita d'en servir à tous les autres; il repandit même une plus grande lumière sur les découvertes du philosophe Anglois, il les rendit pour ainsi dire sensibles, et c'est grace à lui qu'elles sont devenues communes et familières. En un mot, la saine Métaphysique ne date en France, que des ouvrages de Condillac, et à ce titre il doit être compté dans le petit nombre d'hommes qui ont avancé la science qu'ils ont cultivée."—(*Lycée*, Tome XV. pp. 136, 137.)

La Harpe proceeds in the same panegyrical strain through more than seventy pages, and concludes his eulogy of Condillac with these words: "Le style de Condillac est clair et pur comme ses conceptions; c'est en general l'esprit le plus juste et le plus lumineux qui ait contribué, dans ce siècle, aux progrès de la bonne philosophie."—(*Ibid.* p. 214.)

La Harpe's account of the power of *Reflexion*, will form an appropriate supplement to his comments on Condillac. "L'impression sentie des objets se nomme *perception*; l'action de l'ame qui les considère, se nomme *reflexion*. Ce mot, il est vrai, exprime un mouvement physique, celui de se replier sur soi-même ou sur quelque chose; mais *toutes nos idées venant des sens*, nous sommes souvent obligés de nous servir de termes physiques pour exprimer les opérations de l'âme."—(*Ibid.* p. 158.) In another passage he defines Reflection as follows: "La faculté de reflexion, c'est-à-dire, le pouvoir qu'a notre âme de comparer, d'assembler, de combiner les perceptions."—(*Ibid.* p. 183.) How widely do these definitions of reflection differ from that given by Locke; and how exactly do they accord with the Philosophy of Gassendi, of Hobbes, and of Diderot!

In a lately published sketch *Of the State of French Literature during the eighteenth century* (a work, to which the Author's taste and powers as a writer have attracted a degree of public attention something beyond what was due to his philosophical depth and discernment), there are some shrewd, and, in my opinion, sound remarks, on the *moral* tendency of that metaphysical system to which Condillac gave so much

* Hartley on Man, 4th Edit. p. [illegible] of the Introduction.

ty of moral distinctions. The consideration of such questions, it may at first sight be thought, belongs rather to the history of Ethics than of Metaphysics; but it must be recollected, that, in introducing them here, I follow the example of Locke himself, who has enlarged upon them at considerable length, in his Argument against the Theory of *Innate Ideas*. An *Ethical* disquisition of this sort formed, it must be owned, an awkward introduction to a work on the Human Understanding; but the conclusion on which it is meant to bear is purely of a *Metaphysical* nature; and when combined with the premises from which it is deduced, affords a good illustration of the impossibility, in tracing the progress of these two sciences, of separating completely the history of the one from that of the other.

In what sense Locke's reasonings against *Innate Ideas* have been commonly understood, may be collected from the following passage of an author, who had certainly no wish to do injustice to Locke's opinions.

"The First Book (says Dr Beattie) of the *Essay on Human Understanding*, which, with submission, I think the worst, tends to establish this dangerous doctrine, that the human mind, previous to education and habit, is as susceptible of any one impression as of any other:—a doctrine which, if true, would go near to prove, that truth and virtue are

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circulation and celebrity. I shall quote some of his strictures which bear more particularly on the foregoing argument.

"Autrefois, negligeant d'examiner tout ce mécanisme des sens, tous ces rapports directs du corps avec les objets, les philosophes ne s'occupoient que de ce qui se passe au-dedans de l'homme. La science de l'âme, telle a été la noble étude de Descartes, de Pascal, de Malebranche, de Leibnits. (Why omit in this list the name of Locke?) ..... Peut-être se perdoient-ils quelquefois dans les nuages des hautes régions ou ils avoient pris leur vol, peut-être leurs travaux etoient-ils sans application directe; mais du moins ils suivoient une direction élevée, leur doctrine étoit en rapport avec les pensées qui nous agitent quand nous reflèchissons profondément sur nous-mêmes Cette route conduisoit nécessairement au plus nobles des sciences, à la religion, et à la morale. Elle supposoit dans ceux qui la cultivoient un génie élévé et de vastes meditations.

"On se lassa de les suivre; on traita de vaines subtilités, on flétrit du titre de réveries scholastiques les travaux de ces grandes esprits. On se jeta dans la science des sensations, espérant qu'elle seroit plus à la portee de l'intelligence humaine. On s'occupa de plus en plus des rapports mécaniques de l'homme avec les objets, et de l'influence de son organisation physique. De cette sorte, la métaphysique alla toujours se rabaissant, au point que maintenant, pour quelques personnes, elle se confond presque avec la physiologie. . . . Le dix-huitième siècle a voulu faire de cette manière d'envisager l'homme un de ses principaux titres de gloire. . . . .

"Condillac est le chef de cette école. C'est dans ses ouvrages que cette métaphysique exerce toutes les seductions de la méthode, et de la lucidité; d'autant plus claire, qu'elle est moins profonde. Peu d'écrivains ont obtenu plus de succès. Il reduisit à la portée du vulgaire la science de la pensée, en retranchant tout ce qu'elle avoit d'élevée. Chacun fut surpris et glorieux de pouvoir philosopher si facilement; et l'on eut une grande reconnoissance pour celui à qui l'on devoit ce bienfait. On ne s'apperçut pas qu'il avoit rabaissé la science, au lieu de rendre ses disciples capable d'y atteindre."—(*Tableau de la Littérature Françoise pendant le dix-huitième Siècle*, pp. 87, 88, 89, 92.)

no better than human contrivances; or, at least, that they have nothing permanent in their nature; but may be as changeable as the inclinations and capacities of men." Dr Beattie, however, candidly and judiciously adds, "Surely this is not the doctrine that Locke *meant* to establish; but his zeal against innate ideas, and innate principles, put him off his guard, and made him allow too little to instinct, for fear of allowing too much."

In this last remark, I perfectly agree with Dr Beattie; although I am well aware, that a considerable number of Locke's English disciples have not only chosen to interpret the first book of his *Essay* in that very sense in which it appeared to Dr Beattie to be of so mischievous a tendency, but have avowed Locke's doctrine, when thus interpreted, as their own ethical creed. In this number, I am sorry to say, the respectable name of Paley must be included.[1]

It is fortunate for Locke's reputation, that, in other parts of his *Essay*, he has disavowed, in the most unequivocal terms, those dangerous conclusions which, it must be owned, the general strain of his first book has too much the appearance of favouring. "He that hath the idea (he observes on one occasion) of an intelligent, but frail and weak being, made by and depending on another, who is omnipotent, perfectly wise, and good, will as certainly know, that man is to honour, fear, and obey God, as that the sun shines when he sees it; nor can he be surer, in a clear morning, that the sun is risen, if he will but open his eyes, and turn them that way. But yet these truths being never so certain, never so clear, he may be ignorant of either, or all of them, who will never take the pains to employ his faculties as he should to inform himself about them." To the same purpose, he has elsewhere said, that "there is a *Law of Nature*, as intelligible to a *rational creature and studier of that law*, as the positive laws of commonwealths." Nay, he has himself, in the most explicit terms, anticipated and disclaimed those dangerous consequences which, it has been so often supposed, it was the chief scope of this introductory chapter to establish. "I would not be mistaken, as if, because I deny an innate law, I thought there were none but positive laws. There is a great deal of difference between an innate law and a law of nature; between something imprinted on our minds in their very original, and something that we, being ignorant of, may attain to the knowledge of, by the use and due application of our natural faculties. And I think they equally forsake the truth, who, running into the contrary extremes, either affirm an innate law, or deny that there is a law knowable by the light of nature, without the help of a positive revelation." (Vol. I. p. 44.) Nor was Locke unaware of the influence on men's lives of their

[1] See *Principles of Moral and Political Philosophy*, Book I. Chap. 5, where the author discusses the question concerning a *moral sense*.

speculative tenets concerning these metaphysical and ethical questions. On this point, which can alone render such discussions interesting to human happiness, he has expressed himself thus: "Let that principle of some of the philosophers, that *all is matter, and that there is nothing else*, be received for certain and indubitable, and it will be easy to be seen, by the writings of some that have revived it again in our days, what consequences it will lead into. . . . Nothing can be so dangerous as principles thus taken up without due questioning or examination; especially if they be such as influence men's lives, and give a bias to all their actions. He that with *Archelaus* shall lay it down as a principle, that right and wrong, honest and dishonest, are defined only by laws,* and not by nature, will have other measures of moral rectitude and pravity, than those who take it for granted, that we are under obligations antecedent to all human constitutions." (Vol. III. p. 75.) Is not the whole of this passage evidently pointed at the Epicurean maxims of Hobbes and of Gassendi?[1]

Lord Shaftesbury was one of the first who sounded the alarm against what he conceived to be the drift of that philosophy which denies the existence of *innate principles*. Various strictures on this subject occur in the *Characteristics*; particularly in the treatise entitled *Advice to an Author*; but the most direct of all his attacks upon Locke is to be found in his 8th Letter, addressed to a Student at the University. In this letter he observes, that "all those called *free writers* now-a-days have espoused those principles which Mr Hobbes set a foot in this last age."—"Mr Locke (he continues), as much as I honour him on account of other writings (on Government, Policy, Trade, Coin, Education, Toleration, &c.), and as well as I knew him, and can answer for his sincerity as a most zealous Christian and believer, did however go in the self same tract; and is followed by the Tindals, and all the other free authors of our times!

"'Twas Mr Locke that struck the home blow: for Mr Hobbes's character, and base slavish principles, of government, took off the poison of his philosophy. 'Twas Mr Locke that struck at all fundamentals, threw all *order and virtue* out of the world, and made the very ideas of these (which are the same with those of GOD) *unnatural*, and without foundation in our minds. *Innate* is a word he poorly plays upon: the right word, though less

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[1] To the above quotations from Locke, the following deserves to be added: "Whilst the parties of men cram their tenets down all men's throats, whom they can get into their power, without permiting them to examine their truth or falsehood, and will not let truth have fair play in the world, nor men the liberty to search after it; what improvements can be expected of this kind? What greater light can be hoped for in the moral sciences? The subject part of mankind in most places might, instead thereof, with Egyptian bondage expect Egyptian darkness, *were not the candle of the Lord set up by himself in men's minds, which it is imposible for the breath or power of man wholly to extinguish.*" Vol. II. pp. 343, 344.

used, is *connatural.* For what has *birth* or progress of the fœtus out of the womb to do in this case?—the question is not about the *time* the ideas entered, or the moment that one body came out of the other; but whether the constitution of man be such, that, being adult and grown up,[1] at such a time, sooner or later (no matter when), the idea and sense of *order, administration*, and a GOD, will not infallibly, inevitably, necessarily spring up in him."

In this last remark Shaftesbury appears to me to place the question about *innate ideas* upon the right and only philosophical footing; and to afford a key to all the confusion running through Locke's argument against their existence. The sequel of the above quotation is not less just and valuable—but I must not indulge myself in any farther extracts. It is sufficient to mention the perfect coincidence between the opinion of Shaftesbury, as here stated by himself, and that formerly quoted in the words of Locke; and, of consequence, the injustice of concluding, from some unguarded expressions of the latter, that there was, at bottom, any essential difference between their real sentiments.[2]

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[1] Lord Shaftesbury should have said, "grown up to the possession and exercise of his reasoning powers."

[2] I must, at the same time, again repeat, that the facts and reasonings contained in the introduction to Locke's *Essay* go very far to account for the severity of Shaftesbury's censures on this part of his work. Sir Isaac Newton himself, an intimate friend of Locke's, appears, from a letter of his which I have read in his own handwriting, to have felt precisely in the same manner with the author of the *Characteristics*. Such, at least, were his *first* impressions; although he afterwards requested, with a humility and candour worthy of himself, the forgiveness of Locke for this injustice done to his character. "I beg your pardon (says he) for representing that you struck at the root of morality in a principle you laid down in your book of ideas, and designed to pursue in another book; and that I took you for a Hobbist." In the same letter Newton alludes to certain unfounded suspicions which he had been led to entertain of the propriety of Locke's conduct in some of their private concerns; adding, with an ingenuous and almost infantine simplicity, "I was so much affected with this, that when one told me you was sickly and would not live, I answered, 'twere better if you were dead. I desire you to forgive me this uncharitableness." The letter is subscribed, *your most humble and most unfortunate servant, Is. Newton.**

The rough draught of Mr Locke's reply to these afflicting acknowledgments was kindly communicated to me by a friend some years ago. It is written with the magnanimity of a philosopher, and with the good-humoured forbearance of a man of the world; and it breathes throughout so tender and so unaffected a veneration for the good as well as the great qualities of the excellent person to whom it is addressed, as demonstrates at once the conscious integrity of the writer, and the superiority of his mind to the irritation of little passions. I know of nothing from Locke's pen which does more honour to his temper and character; and I introduce it with peculiar satisfaction, in connection with those strictures which truth has extorted from me on that part of his system which to the moralist stands most in need of explanation and apology.

MR LOCKE TO MR NEWTON.

"SIR, *Oates, 5th October*, 1693.

"I have been ever since I first knew you so kindly and sincerely your friend, and thought you so much mine, that I could not have believed what you tell me of yourself, had I had it from any body else. And

* It is dated *at the Bull in Shoreditch, London, September* 1693; and is addressed, *For John Locke, Esq. at Sir Fra. Masham's, Bart. at Oates, in Essex.*

Under the title of Locke's *Metaphysical* (or, to speak with more strict precision, his *Logical*) writings, may also be classed his tracts on Education, and on the conduct of the Understanding. These tracts are entirely of a practical nature, and were plainly intended for a wider circle of readers than his *Essay;* but they everywhere bear the strongest marks of the same zeal for extending the empire of Truth and of Reason, and may be justly regarded as parts of the same great design.[1] It has been often remarked, that they display less originality than might have been expected from so bold and powerful a thinker; and, accordingly, both of them have long fallen into very general neglect. It ought, however, to be remembered, that, on the most important points discussed in them, new suggestions are not now to be looked for; and that the great object of the reader should be, not to learn something which he never heard of before, but to learn, among the multi-

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though I cannot but be mightily troubled that you should have so many wrong and unjust thoughts of me, yet, next to the return of good offices, such as from a sincere good will I have ever done you, I receive your acknowledgment of the contrary as the kindest thing you could have done me, since it gives me hopes I have not lost a friend I so much valued. After what your letter expresses, I shall not need to say any thing to justify myself to you: I shall always think your own reflection on my carriage both to you and all mankind will sufficiently do that. Instead of that, give me leave to assure you, that I am more ready to forgive you than you can be to desire it; and I do it so freely and fully that I wish for nothing more than the opportunity to convince you that I truly love and esteem you; and that I have still the same good will for you as if nothing of this had happened. To confirm this to you more fully, I should be glad to meet you anywhere, and the rather, because the conclusion of your letter makes me apprehend it would not be wholly useless to you. I shall always be ready to serve you to my utmost, in any way you shall like, and shall only need your commands or permission to do it.

" My book is going to press for a second edition; and, though I can answer for the design with which I writ it, yet, since you have so opportunely given me notice of what you have said of it, I should take it as a favour if you would point out to me the places that gave occasion to that censure, that, by explaining myself better, I may avoid being mistaken by others, or unwillingly doing the least prejudice to truth or virtue. I am sure you are so much a friend to both, that, were you none to me, I could expect this from you. But I cannot doubt but you would do a great deal more than this for my sake, who, after all, have all the concern of a friend for you, wish you extremely well, and am, without compliment," &c. &c.

(For the preservation of this precious memorial of Mr Locke, the public is indebted to the descendants of his friend and relation the Lord Chancellor King, to whom his papers and library were bequeathed. The original is still in the possession of the present representative of that noble family; for whose flattering permission to enrich my Dissertation with the above extracts, I feel the more grateful, as I have not the honour of being personally known to his Lordship.)

[1] Mr Locke, it would appear, had once intended to publish his thoughts on the Conduct of the Understanding, as an additional chapter to his Essay. " I have lately," says he, in a latter to Mr Molyneux, " got a little leisure to think of some additions to my book against the next edition, and within these few days have fallen upon a subject that I know not how far it will lead me. I have written several pages on it, but the matter, the farther I go, opens the more upon me, and I cannot get sight of any end of it. The title of the chapter will be, *Of the Conduct of the Understanding*, which, if I shall pursue as far as I imagine it will reach, and as it deserves, will, I conclude, make the largest chapter of my Essay." (Locke's *Works*, Vol. IX. p. 4[illegible])

plicity of discordant precepts current in the world, *which* of them were sanctioned, and *which* reprobated by the judgment of Locke. The candid and unreserved thoughts of such a writer upon such subjects as Education, and the culture of the intellectual powers, possess an intrinsic value, which is not diminished by the consideration of their triteness. They not only serve to illustrate the peculiarities of the author's own character and views, but, considered in a practical light, come recommended to us by all the additional weight of his discriminating experience. In this point of view, the two tracts in question, but more especially that on the *Conduct of the Understanding*, will always continue to be interesting manuals to such as are qualified to appreciate the mind from which they proceeded.[1]

It must not, however, be concluded from the *apparent* triteness of some of Locke's remarks, to the present generation of readers, that they were viewed in the same light by his own contemporaries. On the contrary, Leibnitz speaks of the *Treatise on Education* as a work of still greater merit than the *Essay on Human Understanding*.[2] Nor will this judgment be wondered at by those who, abstracting from the habits of thinking in which they have been reared, transport themselves in imagination to the state of Europe a hundred years ago. How flat and nugatory seem now the cautions to parents about watching over those associations on which the dread of spirits in the dark is founded! But how different was the case (even in Protestant countries) till a very recent period of the last century!

I have, on a former occasion, taken notice of the slow but (since the invention of printing) certain steps by which Truth makes its way in the world; "the discoveries, which, in one age, are confined to the studious and enlightened few, becoming, in the next, the established creed of the learned; and, in the third, forming part of the elementary princi-

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[1] A similar remark may be extended to a letter from Locke to his friend Mr. Samuel Bold, who had complained to him of the disadvantages he laboured under from a weakness of memory. It contains nothing but what might have come from the pen of one of Newberry's authors; but with what additional interest do we read it, when considered as a comment by Locke on a suggestion of Bacon's! (Locke's *Works*, Vol. X. p. 317.)

It is a judicious reflection of Shenstone's, that "every single observation published by a man of genius, be it ever so trivial, should be esteemed of importance, because he speaks from his own impressions; whereas common men publish common things, which they have perhaps *gleaned* from frivolous writers." I know of few authors to whom this observation applies more forcibly and happily than to Locke, when he touches on the culture of the intellectual powers. His precepts, indeed, are not all equally sound; but they, in general, contain a large proportion of truth, and may always furnish to a speculative mind matter of useful meditation.

[2] Leib. *Op.* Tom. VI. p. 226.

ples of education." The harmony, in the meantime, which exists among truths of all descriptions, tends perpetually, by blending them into one common mass, to increase the joint influence of the whole; the contributions of individuals to this mass (to borrow the fine allusion of Middleton) "resembling the drops of rain, which, falling separately into the water, mingle at once with the stream, and strengthen the general current." Hence the ambition, so natural to weak minds, to distinguish themselves by paradoxical and extravagant opinions; for *these*, having no chance to incorporate themselves with the progressive reason of the species, are the more likely to immortalize the eccentricity of their authors, and to furnish subjects of wonder to the common compilers of literary history. This ambition is the more general, as so little expence of genius is necessary for its gratification. "Truth (as Mr Hume has well observed) is *one thing*, but errors are numberless;" and hence (he might have added) the difficulty of seizing the former, and the facility of swelling the number of the latter.[1]

Having said so much in illustration of Locke's philosophical merits, and in reply to the common charge against his metaphysical and ethical principles, it now only remains for me to take notice of one or two defects in his intellectual character, which exhibit a strong contrast to the general vigour of his mental powers.

Among these defects, the most prominent is, the facility with which he listens to historical evidence, when it happens to favour his own conclusions. Many remarkable instances of this occur in his long and rambling argument (somewhat in the style of Montaigne) against the existence of *innate practical principles;* to which may be added, the degree of credit he appears to have given to the popular tales about mermaids, and to Sir William Temple's idle story of Prince Maurice's "rational and intelligent parrot." Strange! that the same person who, in matters of reasoning, had divested himself, almost to a fault, of all reverence for the opinions of others, should have failed to perceive, that, of all the various sources of error, one of the most copious and fatal is an unreflecting faith in human testimony!

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[1] Descartes has struck into nearly the same train of thinking with the above, but his remarks apply much better to the writings of Locke than to his own.

"L'expérience m'apprit, que quoique mes opinions surprennent d'abord, parce qu'elles sont fort différentes des vulgaires, cependant, après qu'on les a comprises on les trouve si simples et si conformes au sens commun, qu'on cesse entièrement de les admirer, et par la même d'en faire cas: parceque tel est le naturel des hommes qu'ils n'estiment que les choses qui leur laissent d'admiration et qu'ils ne possedent pas tout-a-fait. C'est ainsi que quoique la santé soit le plus grand de tous les biens qui concernent le corps, c'est pourtant celui auquel nous faisons le moins de réflexion, et que nous goutons le moins. Or, la connoissance de la vérité est comme la santé de l'ame; lorsque on la possède on n'y pense plus." (*Lettres*, Tome I. Lettre xliii.)

The disrespect of Locke for the wisdom of antiquity, is another prejudice which has frequently given a wrong bias to his judgment. The idolatry in which the Greek and Roman writers were held by his immediate predecessors, although it may help to account for this weakness, cannot altogether excuse it in a man of so strong and enlarged an understanding. Locke (as we are told by Dr. Warton) " *affected* to depreciate the ancients; which circumstance (he adds), as I am informed from undoubted authority, was the source of perpetual discontent and dispute betwixt him and his pupil, Lord Shaftesbury; who, in many parts of the *Characteristics*, has ridiculed Locke's philosophy, and endeavoured to represent him as a disciple of Hobbes." To those who are aware of the direct opposition between the principles of Hobbes, of Montaigne, of Gassendi, and of the other *minute philosophers* with whom Locke sometimes seems unconsciously to unite his strength,—and the principles of Socrates, of Plato, of Cicero, and of all the soundest moralists, both of ancient and of modern times, the foregoing anecdote will serve at once to explain and to palliate the acrimony of some of Shaftesbury's strictures on Locke's Ethical paradoxes.[1]

With this disposition of Locke to depreciate the ancients, was intimately connected that contempt which he everywhere expresses for the study of Eloquence, and that perversion of taste which led him to consider Blackmore as one of the first of our English poets.[2] That his own imagination was neither sterile nor torpid, appears sufficiently from the agreeable colouring and animation which it has not unfrequently imparted to his style; but *this* power of the mind he seems to have regarded with a peculiarly jealous and unfriendly eye; confining his view exclusively to its occasional effects in misleading the judgment, and overlooking altogether the important purposes to which it is subservient, both in our intellectual and moral frame. Hence, in all his writings, an inattention to those more attractive aspects of the mind, the study of which (as Burke has well observed), " while it communicates to the taste a sort of philosophical solidity, may be expected to reflect back on the severer sciences some of those graces and elegances, without which the greatest proficiency in these sciences will always have the appearance of something illiberal."

To a certain hardness of character, not unfrequently united with an insensibility to the charms of poetry and of eloquence, may partly be ascribed the severe and forbidding spirit

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[1] Plebeii Philosophi (says Cicero) qui a Platone et Socrate, et ab ea familia dissident.

[2] " All our English poets, except Milton," says Molyneux in a letter to Locke, " have been mere ballad-makers in comparison to Sir Richard Blackmore." In reply to which Locke says, " There is, I with pleasure find, a strange harmony throughout between your thoughts and mine." (Locke's *Works*, Vol. IX. pp. 423, 426.)

which has suggested some of the maxims in his *Tract on Education*.[1] He had been treated, himself, it would appear, with very little indulgence by his parents; and probably was led by that filial veneration which he always expressed for their memory, to ascribe to the early habits of self-denial imposed on him by their ascetic system of ethics, the existence of those moral qualities which he owed to the regulating influence of his own reason in fostering his natural dispositions; and which, under a gentler and more skilful culture, might have assumed a still more engaging and amiable form. His father, who had served in the Parliament's army, seems to have retained through life that austerity of manners which characterized his puritanical associates; and, notwithstanding the comparative enlargement and cultivation of Mr Locke's mind, something of this hereditary leaven, if I am not mistaken, continued to operate upon many of his opinions and habits of thinking. If, in the *Conduct of the Understanding*, he trusted (as many have thought) too much to nature, and laid too little stress on logical rules, he certainly fell into the opposite extreme in everything connected with the culture of the heart; distrusting nature altogether, and placing his sole confidence in the effects of a systematical and vigilant discipline. That the great object of education is not to thwart and disturb, but to study the aim, and to facilitate the accomplishment of her beneficial arrangements, is a maxim, one should think, obvious to common sense; and yet it is only of late years that it has begun to gain ground even among philosophers. It is but justice to Rousseau to acknowledge, that the zeal and eloquence with which he has enforced it, go far to compensate the mischievous tendency of some of his other doctrines.

To the same causes it was probably owing, that Locke has availed himself so little in his *Conduct of the Understanding*, of his own favourite doctrine of the Association of Ideas. He has been, indeed, at sufficient pains to warn parents and guardians of the mischievous consequences to be apprehended from this part of our constitution, if not diligently watched over in our infant years. But he seems to have altogether overlooked the positive and immense resources which might be derived from it, in the culture and amelioration, both of our intellectual and moral powers;—in strengthening (for instance), by early *habits* of right thinking, the authority of reason and of conscience;—in blending with our best feelings the congenial and ennobling sympathies of taste and of fancy;—and in identifying, with the first workings of the imagination, those pleasing views of the order of the universe,

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[1] Such, for example, as this, that "a child should never be suffered to have what he craves, or *so much as speaks for*, much less if he cries for it!" A maxim (as his correspondent Molyneux observes) "which seems to bear hard on the tender spirits of children, and the natural affections of parents." (Locke's *Works*, Vol. IX. p. 319.)

which are so essentially necessary to human happiness. A law of our nature, so mighty and so extensive in its influence, was surely not given to man in vain; and the fatal *purchase* which it has, in all ages, afforded to Machiavellian statesmen, and to political religionists, in carrying into effect their joint conspiracy against the improvement and welfare of our species, is the most decisive proof of the manifold uses to which it might be turned in the hands of instructors, well disposed and well qualified humbly to co-operate with the obvious and unerring purposes of Divine Wisdom.

A more convenient opportunity will afterwards occur for taking some notice of Locke's writings on Money and Trade, and on the Principles of Government. They appear to me to connect less naturally and closely with the literary history of the times when they appeared, than with the systematical views which were opened on the same subjects about fifty years afterwards, by some speculative politicians in France and in England. I shall, therefore, delay any remarks on them which I have to offer, till we arrive at the period, when the questions to which they relate began everywhere to attract the attention of the learned world, and to be discussed on those general principles of expediency and equity which form the basis of the modern science of Political Economy. With respect to his merits as a logical and metaphysical reformer, enough has been already said for this introductory section: but I shall have occasion, more than once, to recur to them in the following pages, when I come to review those later theories, of which the germs or rudiments may be distinctly traced in his works; and of which he is, therefore, entitled to divide the praise with such of his successors as have reared to maturity the prolific seeds scattered by his hand.[1]

SECTION II.

Continuation of the Review of Locke and Leibnitz.

LEIBNITZ.

INDEPENDENTLY of the pre-eminent rank, which the versatile talents, and the universal learning of Leibnitz entitle him to hold among the illustrious men who adorned the Continent of Europe during the eighteenth century, there are other considerations which have

[1] And yet with what modesty does Locke speak of his own pretensions as a Philosopher! "In an age that produces such masters as the great Huygenius and the incomparable Mr Newton, it is ambition enough to be employed as an underlabourer in clearing the ground a little, and removing some of the rubbish that lies in the way to knowledge." (*Essay on Human Understanding. Epistle to the Reader.*) See Note (F.)

determined me to unite his name with that of Locke, in fixing the commencement of the period, on the history of which I am now to enter. The school of which he was the founder was strongly discriminated from that of Locke, by the general spirit of its doctrines; and to this school a large proportion of the metaphysicians, and also of the mathematicians of Germany, Holland, France, and Italy, have, ever since his time, had a decided leaning. On the fundamental question, indeed, concerning the *Origin of our Knowledge*, the philosophers of the Continent (with the exception of the Germans, and a few eminent individuals in other countries) have, in general, sided with Locke, or rather with Gassendi; but, in most other instances, a partiality for the opinions, and a deference for the authority of Leibnitz, may be traced in their speculations, both on metaphysical and physical subjects. Hence a striking contrast between the characteristical features of the continental philosophy, and those of the contemporary systems which have succeeded each other in our own island; the great proportion of our most noted writers, notwithstanding the opposition of their sentiments on particular points, having either attached themselves, or professed to attach themselves, to the method of inquiry recommended and exemplified by Locke.

But the circumstance which chiefly induced me assign to Leibnitz so prominent a place in this historical sketch, is the extraordinary influence of his industry and zeal, in uniting, by a mutual communication of intellectual lights and of moral sympathies, the most powerful and leading minds scattered over Christendom. Some preliminary steps towards such an union had been already taken by Wallis in England, and by Mersenne in France; but the *literary commerce*, of which they were the centres, was confined almost exclusively to Mathematics and to Physics; while the comprehensive correspondence of Leibnitz extended alike to every pursuit interesting to man, either as a speculative or as an active being. From this time forward, accordingly, the history of philosophy involves, in a far greater degree than at any former period, the general history of the human mind; and we shall find, in our attempts to trace its farther progress, our attention more and more irresistibly withdrawn from local details to more enlarged views of the globe which we inhabit. A striking change in this literary commerce among nations took place, at least in the western parts of Europe, before the death of Leibnitz; but, during the remainder of the last century, it continued to proceed with an accelerated rapidity over the whole face of the civilized world. A multitude of causes, undoubtedly, conspired to produce it; but I know of no individual whose name is better entitled, than that of Leibnitz, to mark the era of its commencement.[1]

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[1] The following maxims of Leibnitz deserve the serious attention of all who have at heart the improvement of mankind:

I have already, in treating of the philosophy of Locke, said enough, and perhaps more than enough, of the opinion of Leibnitz concerning the origin of our knowledge. Although expressed in a different phraseology, it agrees in the most essential points with the *innate ideas* of the Cartesians; but it approaches still more nearly to some of the mystical speculations of Plato. The very exact coincidence between the language of Leibnitz on this question, and that of his contemporary Cudworth, whose mind, like his own, was deeply tinctured with the Platonic Metaphysics, is not unworthy of notice here, as an historical fact; and it is the only remark on this part of his system which I mean to add at present to those in the preceding history.

" The *seeds* of our acquired knowledge," says Leibnitz, " or, in other words, our *ideas*, and the eternal truths which are derived from them, are contained in the mind itself; nor is this wonderful, since we know by our own consciousness, that we possess within ourselves the ideas of *existence*, of *unity*, of *substance*, of *action*, and other ideas of a similar nature." To the same purpose, we are told by Cudworth, that " the mind contains in itself virtually (as the future plant or tree is contained in the *seed*) general notions of all things which unfold and discover themselves as occasions invite, and proper circumstances occur."

The metaphysical theories, to the establishment of which Leibnitz chiefly directed the force of his genius, are the doctrine of *Pre-established Harmony*; and the scheme of *Optimism*, as new modelled by himself. On neither of these heads will it be necessary for me long to detain my readers.

1. According to the system of *Pre-established Harmony*, the human mind and human body are two independent but constantly correspondent machines;—adjusted to each other like two unconnected clocks, so constructed, that, at the same instant, the one should *point* the hour, and the other *strike* it. Of this system the following summary and illustration are given by Leibnitz himself, in his Essay entitled *Theodicæa*:

" I cannot help coming into this notion, that God created the *soul* in such manner at first, that it should *represent* within itself all the simultaneous changes in the body; and that he has made the body also in such manner, as that it must of itself do what the soul wills:—So that the laws which make the thoughts of the soul follow each other in regular

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" On trouve dans le monde plusieurs personnes bien intentionnées; mais le mal est, qu'elles ne s'entendent point, et ne travaillent point de concert. S'il y avoit moyen de trouver une espéce de glu pour les reunir, on feroit quelque chose. Le mal est souvent que les gens de bien ont quelques caprices ou opinions particulières, qui font qu'ils sont contraires entr'eux . . . . L'esprit sectaire consiste proprement dans cette prétention de vouloir que les autres se reglent sur nos maximes, au lieu qu'on se devroit contenter de voir qu'on aille au but principal." (Leib. *Op.* Tom. I. p. 740.)

succession, must produce *images* which shall be coincident with the impressions made by external objects upon our organs of sense; while the laws by which the motions of the body follow each other, are likewise so coincident with the thoughts of the soul, as to give to our *volitions* and *actions* the very same appearance, as if the latter were really the natural and the necessary consequences of the former." (Leib. *Op.* I. p. 163.) Upon another occasion he observes, that "everything goes on in the soul as if it had no body, and that everything goes on in the body as if it had no soul." (*Ibid.* II. p. 44.)

To convey his meaning still more fully, Leibnitz borrows from Mr Jaquelot[1] a comparison, which, whatever may be thought of its justness, must be at least allowed some merit in point of ingenuity. "Suppose that an intelligent and powerful being, who knew, beforehand, every particular thing that I should order my footman to do to-morrow, should make a machine to resemble my footman exactly, and punctually to perform, all day, whatever I directed. On this supposition, would not *my will*, in issuing all the details of my orders, remain, in every respect, in the same circumstances as before? And would not my machine-footman, in performing his different movements, have the appearance of acting only in obedience to my commands?" The inference to be drawn from this comparison is, that the movements of my body have no direct dependence whatever on the volitions of my mind, any more than the actions of my machine-footman would have on the words issuing from my lips. The same inference is to be extended to the relation which the *impressions* made on my different senses bear to the co-existent perceptions arising in my mind. The impressions and perceptions have no mutual *connection*, resembling that of physical causes with their effects; but the one series of events is made to correspond invariably with the other, in consequence of an eternal *harmony* between them, *pre-established* by their common Creator.

From this outline of the scheme of *Pre-established Harmony*, it is manifest, that it took its rise from the very same train of thinking which produced Malebranche's doctrine of *Occasional Causes*. The authors of both theories saw clearly the impossibility of tracing the mode in which mind acts on body, or body on mind; and hence were led rashly to conclude, that the *connection* or *union* which seems to exist between them is not real, but apparent. The inferences, however, which they drew from this common principle were directly opposite; Malebranche maintaining, that the communication between mind and body was carried on by the immediate and incessant agency of the Deity; while Leibnitz conceived, that the agency of God was employed only in the original contrivance and

[1] Author of a book entitled *Conformité de la Foi avec la Raison.*

mutual adjustment of the two machines;—all the subsequent phenomena of each, being the necessary result of its own independent mechanism, and, at the same time, the progressive evolutions of a comprehensive design, harmonizing the laws of the one with those of the other.

Of these two opposite hypotheses, that of Leibnitz is by far the more unphilosophical and untenable. The chief objection to the doctrine of *occasional causes* is, that it presumes to decide upon a question of which human reason is altogether incompetent to judge;—our ignorance of the mode in which matter acts upon mind, or mind upon matter, furnishing not the shadow of a proof that the one may not act directly and immediately on the other, in some way incomprehensible by our faculties.[1] But the doctrine of

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[1] The mutual action (or, as it was called in the schools), the mutual *influence* (*influxus*) of soul and body, was, till the time of Descartes, the prevailing hypothesis, both among the learned and the vulgar. The reality of this *influx*, if not positively denied by Descartes, was at least mentioned by him as a subject of doubt; but by Malebranche and Leibnitz it was confidently rejected as absurd and impossible. (See their works *passim.*) Gravesande, who had a very strong leaning towards the doctrines of Leibnitz, had yet the good sense to perceive the inconclusiveness of his reasoning in this particular instance, and states in opposition to it the following sound and decisive remarks: "Non concipio, quomodo mens in corpus agere possit; non etiam video, quomodo ex motu nervi perceptio sequatur; non tamen indè sequi mihi apparet, omnem *influxum* esse rejiciendum.

"Substantiæ incognitæ sunt. Jam vidimus naturam mentis nos latere; scimus hanc esse aliquid, quod ideas habet, has confert, &c. sed ignoramus quid sit subjectum, cui hæ proprietates conveniant.

"Hoc idem de corpore dicimus; est extensum, impenetrabile, &c. sed quid est quod habet hasce proprietates? Nulla nobis via aperta est, quâ ad hanc cognitionem pervenire possimus.

"Indè concludimus, multa nos latere, quæ proprietates mentis et corporis spectant.

"Invictâ demonstratione constat, non mentem in corpus, neque hoc in illam agere, ut corpus in corpus agit: sed mihi non videtur indè concludi posse, omnem *influxum* esse impossibilem.

"Motu suo corpus non agit in aliud corpus, sine resistente; sed an non actio, omnino diversa, et cujus ideam non habemus, in aliam substantiam dari possit, et ita tamen, ut causa effectui respondeat, in re adeò obscurâ, determinare non ausim. Difficile certè est influxum negare, quando exactè perpendimus, quomodò in minimis quæ mens percipit, relatio detur cum agitationibus in corpore, et quomodò hujus motus cum mentis determinationibus conveniant. Attendo ad illa quæ medici, et anatomici, nos de his docent.

"Nihil, ergo, de systemate *influxus* determino, præter hoc, mihi mondum hujus impossibilitatem satis clarè demonstratam esse videri."—(*Introductio ad Philosophiam.*) See Note (G.)

With respect to the *manner* in which the intercourse between Mind and Matter is carried on, a very rash assertion escaped Mr. Locke in the first edition of his *Essay.* "The next thing to be considered is, how bodies produce ideas in us, *and that is manifestly by impulse, the only way which we can conceive bodies operate in.*" (*Essay*, B. II. ch. viii. § 11.)

In the course of Locke's controversial discussions with the Bishop of Worcester, he afterwards became fully sensible of this important oversight; and he had the candour to acknowledge his error in the following terms: "'Tis true, I have said, that bodies operate by impulse, and nothing else. And so I thought when I writ it, and can yet conceive no other way of their operations. But I am since convinced, by the judicious Mr Newton's incomparable book, that it is too bold a presumption to limit God's power in this

Pre-established Harmony, besides being equally liable to this objection, labours under the additional advantage of involving a perplexed and totally inconsistent conception of the nature of *Mechanism*;—an inconsistency, by the way, with which all those philosophers are justly chargeable, who imagine that, by likening the universe to a machine, they get rid of the necessity of admitting the constant agency of powers essentially different from the known qualities of matter. The word *Mechanism* properly expresses a combination of natural powers to produce a certain effect. When such a combination is successful, a machine, once set a going, will sometimes continue to perform its office for a considerable time, without requiring the interposition of the artist: And hence we are led to conclude, that the case may perhaps be similar with respect to the universe, when once put into motion by the Deity. This idea Leibnitz carried so far as to exclude the supposition of any subsequent agency in the first contriver and mover, excepting in the case of a miracle. But the falseness of the analogy appears from this, that the moving force in every machine is some *natural power*, such as gravity or elasticity; and, consequently, the very idea of mechanism assumes the existence of those active powers, of which it is the professed object of a mechanical theory of the universe to give an explanation. Whether, therefore, with Malebranche, we resolve every effect into the immediate agency of God, or suppose, with the great majority of Newtonians, that he employs the instrumentality of second causes to accomplish his purposes, we are equally forced to admit with Bacon, the necessity not only of a first contriver and mover, but of his constant and efficient concurrence (either immediately or mediately) in carrying his design into execution:—"*Opus* (says Bacon) *quod operatur Deus a primordio usque ad finem.*"

In what I have now said I have confined myself to the idea of *Mechanism* as it applies to the material universe; for, as to this word, when applied by Leibnitz to the mind, which he calls a *Spiritual Automaton*, I confess myself quite unable to annex a meaning to it: I shall not, therefore, offer any remarks on this part of his system.[1]

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point by my narrow conceptions. * * * * * * And, therefore, in the next edition of my book, I will take care to have that passage rectified."

It is a circumstance that can only be accounted for by the variety of Mr Locke's other pursuits, that in all the later editions of the *Essay* which have fallen in my way, the proposition in question has been allowed to remain as it originally stood.

[1] Absurd as the hypothesis of a *Pre-established Harmony* may now appear, not many years have elapsed since it was the prevailing, or rather universal creed, among the philosophers of Germany. "Il fut un temps" (says the celebrated Euler) "ou le systême de l'harmonie pré-établie etoit tellement en vogue dans toute l'Allemagne, que ceux qui en doutoient, passoient pour des ignorans, ou des esprits bornés." (*Lettres de M. Euler à une Princesse d'Allemagne*, 83e Lettre.) It would be amusing to reckon up the succession of metaphysical creeds which have been since swallowed with the same implicit faith by this learned and specula-

To these visionary speculations of Leibnitz, a strong and instructive contrast is exhibited in the philosophy of Locke; a philosophy, the main object of which is less to enlarge our knowledge, than to make us sensible of our ignorance; or (as the author himself expresses it) "to prevail with the busy mind of man to be cautious in meddling with things exceeding its comprehension; to stop when it is at the utmost extent of its tether; and to sit down in a quiet ignorance of those things, which, upon examination, are found to be beyond the reach of our capacities."..... "My right hand writes," says Locke, in another part of his *Essay*, "whilst my left hand is still. What causes rest in one, and motion in the other? Nothing but my will, a thought of my mind; my thought only changing, my right hand rests, and the left hand moves. *This is matter of fact which cannot be denied.* Explain this and make it intelligible, and then the next step will be to understand Creation...... In the meantime, it is an overvaluing ourselves, to reduce all to the narrow measure of our capacities; and to conclude all things impossible to be done, whose manner of doing exceeds our comprehension...... If you do not understand the operations of your own finite Mind, that thinking thing within you, do not deem it strange that you cannot comprehend the operations of that eternal infinite Mind, who made and governs all things, and whom the heaven of heavens cannot contain."[1] (Vol. II. pp. 249, 250.)

This contrast between the philosophical characters of Locke and of Leibnitz is the more deserving of notice, as something of the same sort has ever since continued to mark and to discriminate the metaphysical researches of the English and of the German schools. Various exceptions to this remark may, no doubt, be mentioned; but these exceptions will be found of trifling moment, when compared with the indisputable extent of its general application.

The theory of pre-established harmony led, by a natural and obvious transition, to the scheme of Optimism. As it represented all events, both in the physical and moral

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tive, and (in all those branches of knowledge where imagination has no influence over the judgment) profound and inventive nation.

[1] That this is a fair representation of the scope of Locke's philosophy, according to the author's own view of it, is demonstrated by the two mottos prefixed to the *Essay on Human Understanding*. The one is a passage of the book of *Ecclesiastes*, which, from the place it occupies in the front of his work, may be presumed to express what he himself regarded as the most important moral to be drawn from his speculations. "As thou knowest not what is the way of the spirit, nor how the bones do grow in the womb of her that is with child; even so, thou knowest not the works of God, who maketh all things." The other motto (from Cicero) strongly expresses a sentiment which every competent judge must feel on comparing the above quotations from Locke, with the *monads* and the *pre-established harmony* of Leibnitz. "Quam bellum est velle confiteri potius nescire quod nescias, quam ista effutientem nauseare, atque ipsum sibi displicere!" See Note (H.)

worlds, as the necessary effects of a mechanism originally contrived and set a-going by the Deity, it reduced its author to the alternative of either calling in question the Divine power, wisdom, and goodness, or of asserting that the universe which he had called into being was the best of all possible systems. This last opinion, accordingly, was eagerly embraced by Leibnitz; and forms the subject of a work entitled *Theodicæa*, in which are combined together, in an extraordinary degree, the acuteness of the logician, the imagination of the poet, and the impenetrable, yet sublime darkness, of the metaphysical theologian.[1]

The modification of Optimism, however, adopted by Leibnitz, was, in some essential respects, peculiar to himself. It differed from that of Plato, and of some other sages of antiquity, in considering the human mind in the light of a *spiritual machine*, and, of consequence, in positively denying the freedom of human actions. According to Plato, every thing is right, so far as it is the work of God;—the creation of beings endowed with free will, and consequently liable to moral delinquency;—and the government of the world by general laws, from which occasional evils *must* result;—furnishing no objection to the perfection of the universe, to which a satisfactory reply may not be found in the partial and narrow views of it, to which our faculties are at present confined. But he held at the same time, that, although the permission of moral evil does not detract from the goodness of God, it is nevertheless imputable to man as a fault, and renders him justly obnoxious to punishment. This system (under a variety of forms) has been in all ages maintained by the wisest and best philosophers, who, while they were anxious to vindicate the perfections of God, saw the importance of stating their doctrine in a manner not inconsistent with man's free will and moral agency.

The scheme of Optimism, on the contrary, as proposed by Leibnitz, is completely subversive of these cardinal truths. It was, indeed, viewed by the great and excellent author in a very different light; but in the judgment of the most impartial and profound inquirers, it leads, by a short and demonstrative process, to the annihilation of all moral distinctions.[2]

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[1] "La Théodicée seule (says Fontenelle) suffiroit pour representer M. Leibnitz. Une lecture immense, des anecdotes curieuses sur les livres ou les personnes, beaucoup d'équité et même de faveur pour tous les auteurs cités, fut ce en les combattant; des vues sublimes et lumineuses, des raisonnemens au fond desquels on sent toujours, l'ésprit géometrique, un style où la force domine, et où cependant sont admis les agrémens d'une imagination heureuse."—*Eloge de Leibnitz.*

[2] It is observed by Dr Akenside, that "the Theory of Optimism has been delivered of late, especially abroad, in a manner which subverts the freedom of human actions; whereas Plato appears very careful to preserve it, and has been in that respect imitated by the best of his followers." (Notes on the 2d Book of the *Pleasures of the Imagination*.)

It is of great importance to attend to the distinction between these two systems; because it has, of late, become customary among sceptical writers to confound them studiously together, in order to extend to both that ridicule to which the latter is justly entitled.

I am perfectly aware, at the same time, that different opinions have been entertained of Plato's real sentiments on this subject; and I readily grant that passages with respect to Fate and Necessity may be collected from his works, which it would be very difficult to reconcile with any one consistent scheme. (See the Notes of Mosheim on his Latin Version of Cudworth's *Intellectual System,* Tome I. pp. 10, 310, *et seq.* Lugd. Batav. 1773.)

Without entering at all into this question, I may be permitted here to avail myself, for the sake of conciseness, of Plato's name, to distinguish that modification of optimism which I have opposed in the text to the optimism of Leibnitz. The following sentence, in the 10th Book *De Republica,* seems sufficient of itself to authorise this liberty: Αρετη δ' αδεσποτος, ην τιμων και ατιμαζων, πλεον και ελαττον αυτης ἑξει. αιτια ἑλομενου. Θεος αναιτιος. *Virtus inviolabilis ac libera quam prout honerabit quis aut negliget, ita plus aut minus ex ea possidebit. Eligentis quidem culpa est omnis. Deus vero extra culpam.*

A short abstract of the allegory with which Leibnitz concludes his *Theodicæa,* will convey a clearer idea of the scope of that work, than I could hope to do by any metaphysical comment. The ground-work of this allegory is taken from a dialogue on Free-Will, written by Laurentius Valla, in opposition to Boethius;—in which dialogue, Sextus, the son of Tarquin the Proud, is introduced as consulting Apollo about his destiny. Apollo predicts to him that he is to violate Lucretia, and afterwards, with his family, to be expelled from Rome. *(Exul inopsque cades irata pulsus ab urbe.)* Sextus complains of the prediction. Apollo replies, that the fault is not his; that he has only the gift of seeing into futurity;* that all things are regulated by Jupiter; and that it is to him his complaint should be addressed. *(Here finishes the allegory of Valla, which Leibnitz thus continues, agreeably to his own principles.)* In consequence of the advice of the Oracle, Sextus goes to Dodona to complain to Jupiter of the crime which he is destined to perpetrate. "Why (says he) oh Jupiter! have you made me wicked and miserable? Either change my lot and my will, or admit that the fault is yours, not mine." Jupiter replies to him: "Renounce all thoughts of Rome and of the crown; be wise and you shall be happy. If you return to Rome you are undone." Sextus, unwilling to submit to such a sacrifice, quits the Temple, and abandons himself to his fate.

After his departure, the high Priest, Theodorus, asks Jupiter why he had not given another *Will* to Sextus. Jupiter sends Theodorus to Athens to consult Minerva. The goddess shows him the Palace of the Destinies, where are representations of all possible worlds,† each of them containing a Sextus Tarquinius with a different *Will,* leading to a catastrophe more or less happy. In the last and best of these worlds, forming the summit of the pyramid composed by the others, the high priest sees Sextus go to Rome, throw every thing into confusion, and violate the wife of his friend. "You see" (says the Goddess of Wisdom) "it was not my father that made Sextus wicked. He was wicked from all eternity, and he was always so in consequence of his own will.‡ Jupiter has only bestowed on him that existence which he could not refuse him in the best of all possible worlds. He only transferred him from the region of *possible* to that of *actual* beings. What great events does the crime of Sextus draw after it? The liberty of Rome—the rise of a government fertile in civil and military virtues, and of an empire destined to conquer and to civilize the earth." Theodorus returns thanks to the goddess, and acknowledges the justice of Jupiter.

* "Futura novi, non facio."

† *World* (it must be remembered) is here synonymous with *Universe.*

‡ "Vides Sextum a Patre meo non fuisse factum improbum, talis quippe ab omni æternitate fuit, et quidem semper liberè; existere tantum ei concessit Jupiter, quod ipsum profecto ejus sapientia mundo, in quo ille continebatur, denegare non poterat: ergo Sextum e regione possibilium ad rerum existentium classem transtulit."

This, in particular, was the case with Voltaire, who, in many parts of his later works, and more especially in his *Candide*, has, under the pretence of exposing the extravagancies of Leibnitz, indulged his satirical raillery against the order of the universe. The success of his attempt was much aided by the confused and inaccurate manner in which the scheme of optimism had been recently stated by various writers, who, in their zeal to "vindicate the ways of God," had been led to hazard principles more dangerous in their consequences than the prejudices and errors which it was their aim to correct.[1]

The zeal of Leibnitz in propagating the dogma of Necessity is not easily reconcileable with the hostility which (as I have already remarked) he uniformly displays against the congenial doctrine of Materialism. Such, however, is the fact, and I believe it to be quite unprecedented in the previous history of philosophy. Spinosa himself has not pushed the argument for necessity further than Leibnitz,—the reasonings of both concluding

[1] Among this number must be included the author of the *Essay on Man*, who, from a want of precision in his metaphysical ideas, has unconsciously fallen into various expressions, equally inconsistent with each other and with his own avowed opinions:

> If plagues and earthquakes break not Heaven's design,
> Why then a Borgia or a Catiline?—
> Who knows but He whose hand the lightning forms,
> Who heaves old Ocean, and who wings the storms,
> Pours fierce ambition on a Cæsar's mind,
> Or turns young Ammon loose to scourge Mankind?—
> * * * * *
> —The general order, since the whole began,
> Is kept in Nature, and is kept in Man.

This approaches very nearly to the optimism of Leibnitz, and has certainly nothing in common with the optimism of Plato. Nor is it possible to reconcile it with the sentiments inculcated by Pope in other parts of the same poem.

> What makes all physical and moral ill?
> There deviates Nature, and here wanders Will.

In this last couplet he seems to admit, not only that *Will* may *wander*, but that *Nature* herself may *deviate* from the *general order*; whereas the doctrine of his universal prayer is, that, while the material world is subjected to established laws, man is left to be the arbiter of his own destiny

> Yet gav'st me in this dark estate
> To know the good from ill,
> And, binding Nature fast in fate,
> Left free the human will.

In the Dunciad, too, the scheme of *Necessity* is coupled with that of *Materialism*, as one of the favourite doctrines of the sect of free-thinkers.

> Of nought so certain as our *Reason* still,
> Of nought so doubtful as of *Soul* and *Will*.

"Two things" (says Warburton, who professes to speak Pope's sentiments) "the most self-evident, the existence of our souls and the freedom of our will!"

not less forcibly against the free-will of God than against the free-will of man, and, of consequence, terminating ultimately in *this* proposition, that no event in the universe could possibly have been different from what has actually taken place.[1] The *distinguishing* feature of this article of the Leibnitzian creed is, that, while the Hobbists and Spinosists were employing their ingenuity in connecting together Materialism and Necessity, as branches springing from one common root, Leibnitz always speaks of the soul as a machine purely *spiritual*,[2]—a machine, however, as necessarily regulated by pre-ordained and immutable laws as the movements of a clock or the revolutions of the planets. In consequence of holding this language, he seemed to represent Man in a less degraded light than other necessitarians; but, in as far as such speculative tenets may be supposed to have any practical effect on human conduct, the tendency of his doctrines is not less dangerous than that of the most obnoxious systems avowed by his predecessors.[3]

The scheme of necessity was still farther adorned and sublimed in the *Theodicæa* of Leibnitz, by an imagination nurtured and trained in the school of Plato. " May there not exist" (he asks on one occasion) " an immense space beyond the region of the stars?

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[1] So completely, indeed, and so mathematically linked, did Leibnitz conceive all truths, both physical and moral, to be with each other, that he represents the eternal geometrician as incessantly occupied in the solution of this problem,—*The state of one Monad (or elementary atom) being given, to determine the state, past, present, and future, of the whole universe.*

[2] " Cuncta itaque in homine certa sunt, et in antecessum determinata, uti in cæteris rebus omnibus, et anima humana est *spirituale quoddam automatum.*" (Leib. *Op.* Tom. I. p. 156.)

In a note on this sentence, the editor quotes a passage from Bilfinger, a learned German, in which an attempt is made to vindicate the propriety of the phrase, by a reference to the etymology of the word *automaton.* This word, it is observed, when traced to its source, literally expresses something which contains within itself its principle of motion, and, consequently, it applies still more literally to *Mind* than to a machine. The remark, considered in a philological point of view, is indisputably just; but is it not evident, that it leads to a conclusion precisely contrary to what this author would deduce from it? Whatever may have been the primitive meaning of the word, its common, or rather its universal meaning, even among scientific writers, is a *material* machine, moving without any foreign impulse; and, that this was the idea annexed to it by Leibnitz, appears from his distinguishing it by the epithet *spirituale*,—an epithet which would have been altogether superfluous had he intended to convey the opinion ascribed to him by Bilfinger. In applying, therefore, this language to the mind, we may conclude, with confidence, that Leibnitz had no intention to contrast together mind and body, in respect of their moving or actuating principles, but only to contrast them in respect of the *substances* of which they are composed. In a word, he conceived both of them to be equally *machines*, made and wound up by the Supreme Being; but the machinery in the one case to be material, and in the other spiritual.

[3] The following remark in Madame de Staël's interesting and eloquent review of German philosophy bears marks of a haste and precipitation with which her criticisms are seldom chargeable: " Les opinions de Leibnitz tendent surtout au perfectionnement moral, s'il est vrai, comme les philosophes Allemands ont taché de le prouver, que le libre arbitre repose sur la doctrine qui affranchit l'ame des objets exterieures, et que la vertu ne puisse exister sans la parfaite independance du vouloir."

and may not this *empyreal* heaven be filled with happiness and glory? It may be conceived to resemble an ocean, where the rivers of all those created beings that are destined for bliss shall finish their course, when arrived in the starry system, at the perfection of their respective natures." (Leib. *Op.* Tom. I. p. 135.)[1]

In various other instances, he rises from the deep and seemingly hopeless abyss of *Fatalism*, to the same lofty conceptions of the universe; and has thus invested the most humiliating article of the atheistic creed, with an air of Platonic mysticism. The influence of his example appears to me to have contributed much to corrupt the taste and to bewilder the speculations of his countrymen; giving birth, in the last result, to that heterogeneous combination of all that is pernicious in Spinozism, with the transcendental eccentricities of a heated and exalted fancy, which, for many years past, has so deeply tinctured both their philosophy and their works of fiction.[2]

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[1] The celebrated *Charles Bonnet*, in his work entitled *Contemplation de la Nature*, has indulged his imagination so far, in following out the above conjecture of Leibnitz, as to rival some of the wildest flights of Jacob Behmen. "Mais l'échelle de la création ne se termine point au plus élevés des mondes planétaires. Là commence un autre univers, dont l'étendue est peut-être à celle de l'univers des *Fixes*, ce qu'est l'espace du système solaire à la capacité d'une noix.

"Là, comme des ASTRES resplendissans, brillent les HIERARCHIES CELESTES.

"Là rayonnent de toutes parts les ANGES, les ARCHANGES, les SERAPHINS, les CHERUBINS, les TRONES, les VERTUS, les PRINCIPAUTES, les DOMINATIONS, les PUISSANCES.

"Au centre de ces AUGUSTES SPHERES, éclate le SOLEIL DE JUSTICE, l'ORIENT D'ENHAUT, dont tous les ASTRES empruntent leur lumière et leur splendeur."

"La *Theodicée* de Leibnitz" (the same author tells us in another passage) "est un de mes livres de devotion: J'ai intitulé mon Exemplaire, *Manuel de Philosophie Chrétienne*."

[2] "The gross appetite of Love" (says Gibbon) becomes most dangerous when it is elevated, or rather disguised, by sentimental passion." The remark is strikingly applicable to some of the most popular novels and dramas of Germany; and something very similar to it will be found to hold with respect to those speculative extravagancies which, in the German systems of philosophy, are *elevated or disguised* by the imposing cant of moral enthusiasm.

In one of Leibnitz's controversial discussions with Dr Clarke, there is a passage which throws some light on his taste, not only in matters of science, but in judging of works of imagination. "Du temps de M. Boyle, et d'autres excellens hommes qui fleurissoient en Angleterre sous Charles II. on n'auroit pas osé nous debiter des notions si creuses. (*The notions here alluded to are those of Newton concerning the law of gravitation.*) J'espere que le beautemps reviendra sous un aussi bon gouvernement que celui d'à present. Le capital de M. Boyle etoit d'inculquer que tout se faisoit *mechaniquement* dans la physique. Mais c'est un malheur des hommes, de se degouter enfin de la raison même, et de s'ennuyer de la lumière. Les chimères commence à revenir, et plaisent parce qu'elles ont quelque chose de merveilleux. Il arrive dans le pays philosophique ce qui est arrivé dans le pays poetique. On s'est lassé des Romans raisonnables, tel que *la Clélie Françoise* ou *l'Aramene Allemande*; et on est revenu depuis quelque temps aux *Contes des Fées*." (*Cinquième Ecrit de* M. Leibnitz, p. 266.)

From this passage it would seem, that Leibnitz looked forward to the period, when the dreams of the Newtonian philosophy would give way to some of the exploded mechanical theories of the universe; and

In other parts of Europe, the effects of the *Theodicæa* have not been equally unfavourable. In France, more particularly, it has furnished to the few who have cultivated with success the Philosophy of Mind, new weapons for combating the materialism of the Gassendists and Hobbists; and, in England, we are indebted to it for the irresistible reasonings by which Clarke subverted the foundations on which the whole superstructure of Fatalism rests.[1]

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when the *Fairy-tales* then in fashion (among which number must have been included those of Count Anthony Hamilton) would be supplanted by the revival of such *reasonable Romances* as the *Grand Clelia.* In neither of these instances does there seem to be much probability at present, that his prediction will be ever verified.

The German writers, who, of late years, have made the greatest noise among the sciolists of this country, will be found less indebted for their fame to the new lights which they have struck out, than to the unexpected and grotesque forms in which they have combined together the materials supplied by the invention of former ages, and of other nations. It is this combination of truth and error in their philosophical systems, and of right and wrong in their works of fiction, which has enabled them to perplex the understandings, and to unsettle the principles of so many, both in Metaphysics and Ethics. In point of profound and extensive erudition, the scholars of Germany still continue to maintain their long established superiority over the rest of Europe.

[1] A very interesting account is given by Leibnitz of the circumstances which gave occasion to his *Theodicæa*, in a letter to a Scotch Gentleman, Mr Burnet of Kemney; to whom he seems to have unbosomed himself on all subjects without any reserve. "Mon livre intitulé, *Essais de Theodicée,* sur la bonté de Dieu, la liberté de l'homme, et l'origine de mal, sera bientôt achevé. La plus grande partie de cet ouvrage avoit été faite par lambeaux, quand je me trouvois chez la feue Reine de Prusse, ou ces matières étoient souvent agitées à l'occasion du Dictionnaire et des autres ouvrages de M. Bayle qu'on y lisoit beaucoup. Après la mort de cette grande Princesse, j'ai rassemblé et augmenté ces piéces sur l'exhortation des amis qui en etoient informés, et j'en ai fait l'ouvrage dont je viens de parler. Comme j'ai medité sur cette matière depuis ma jeunesse je pretends de l'avoir discutée à fond." (Leibnitz, *Opera*, Tom VI. p. 284.)

In another letter to the same correspondent, he expresses himself thus:

"La plupart de mes sentimens ont été enfin arretés après une délibération de 20 ans: car j'ai commencé bien jeune à méditer, et je n'avois pas encore 15 ans, quand je me promenois des journées entières dans un bois, pour prendre parti entre Aristote et Democrite. Cependant j'ai changé et rechangé sur des nouvelles lumières, et ce n'est que depuis environ 12 ans que je me trouve satisfait, et que je suis arrivé à des démonstrations sur ces matieres qui n'en paroissent point capables: Cependant de la manière que je m'y prends, ces démonstrations peuvent être sensibles comme celles des nombres, quoique le sujet passe l'imagination." (*Ibid.* p. 253.)

The letter from which this last paragraph is taken is dated in the year 1697.

My chief reason for introducing these extracts, was to do away an absurd suspicion, which has been countenanced by some respectable writers (among others by Le Clerc), that the opinions maintained in the *Theodicæa* of Leibnitz were not his real sentiments, and that his own creed, on the most important questions there discussed, was not very different from that of Bayle. Gibbon has even gone so far as to say, that "in his defence of the attributes and providence of the Deity, he was suspected of a secret correspondence with his adversary." (*Antiquities of the House of Brunswick.*) In support of this very improbable charge, I do not know that any evidence has ever been produced, but the following passage, in a letter of his addressed to a Professor of Theology in the University of Tubingen (Pfaffius): "Ita prorsus est, vir summe reverende, uti scribis, de Theo-

It may be justly regarded as a proof of the progress of reason and good sense among the Metaphysicians of this country since the time of Leibnitz, that the two theories of which I have been speaking, and which, not more than a century ago, were honoured by the opposition of such an antagonist as Clarke, are now remembered only as subjects of literary history.—In the arguments, however, alleged in support of these theories, there are some *logical* principles involved, which still continue to have an extensive influence over the reasonings of the learned, on questions seemingly the most remote from all metaphysical conclusions. The two most prominent of these are, the principle of the *Sufficient Reason*, and the *Law of Continuity;* both of them so intimately connected with some of the most celebrated disputes of the last century, as to require a more particular notice than may, at first sight, seem due to their importance.

I. Of the principle of the *Sufficient Reason*, the following succinct account is given by Leibnitz himself, in his controversial correspondence with Dr Clarke: "The great foundation of Mathematics is the principle of *contradiction* or *identity;* that is, that a proposition cannot be true and false at the same time. But, in order to proceed from Mathematics to Natural Philosophy, another principle is requisite (as I have observed in my *Theodicæa*); I mean the principle of the *Sufficient Reason;* or, in other words, that nothing happens without a *reason* why it should be so, rather than otherwise: And, accordingly, Archimedes was obliged, in his book *De Æquilibrio*, to take for granted, that if there be a balance, in which every thing is alike on both sides, and if equal weights are hung on the two ends of that balance, the whole will be at rest. It is because no *reason* can be given why one side should weigh down rather than the other. Now, by this single

dicæa mea. Rem acu tetigisti; et miror, neminem hactenus fuisse, qui sensum hunc meum senserit. Neque enim Philosophorum est rem serio semper agere; qui in fingendis hypothesibus, uti bene mones, ingenii sui vires experiuntur. Tu, qui Theologus, in refutandis erroribus Theologum agis." In reply to this it is observed, by the learned editor of Leibnitz's works, that it is much more probable that Leibnitz should have expressed himself on this particular occasion in jocular and ironical terms, than that he should have wasted so much ingenuity and learning in support of an hypothesis to which he attached no faith whatever; an hypothesis (he might have added) with which the whole principles of his philosophy are systematically, and, as he conceived, mathematically connected. It is difficult to believe, that, among the innumerable correspondents of Leibnitz, he should have selected a Professor of Theology at Tubingen, as the sole depositary of a secret which he was anxious to conceal from all the rest of the world.

Surely a solitary document such as this weighs less than nothing, when opposed to the details quoted in the beginning of this note; not to mention its complete inconsistency with the character of Leibnitz, and with the whole tenor of his writings.

For my own part, I cannot help thinking, that the passage in question has far more the air of *persifflage* provoked by the vanity of Pfaffius, than of a serious compliment to his sagacity and penetration. No injunction to secrecy, it is to be observed, is here given by Leibnitz to his correspondent.

principle of the *Sufficient Reason*, may be demonstrated the being of a God, and all the other parts of Metaphysics or Natural Theology; and even, in some measure, those physical truths that are independent upon Mathematics, such as the Dynamical Principles, or the Principles of Forces."

Somes of the inferences deduced by Leibnitz from this almost gratuitous assumption are so paradoxical, that one cannot help wondering he was not a little staggered about its certainty. Not only was he led to conclude, that the mind is necessarily determined in all its elections by the influence of motives, insomuch that it would be impossible for it to make a choice between two things perfectly alike; but he had the boldness to extend this conclusion to the Deity, and to assert, that two things perfectly alike could not have been produced even by Divine Power. It was upon this ground that he rejected a *vacuum*, because all the parts of it would be perfectly alike to each other; and that he also rejected the supposition of *atoms*, or similar particles of matter, and ascribed to each particle a *monad*, or active principle, by which it is discriminated from every other particle.[1] The application of his principle, however, on which he evidently valued himself the most, was that to which I have already alluded· the demonstrative evidence with which he conceived it to establish the impossibility of free-agency, not only in man, but in any other intelligent being;[2] a conclusion which, under whatever form of words it may be disguised, is liable to every objection which can be urged against the system of Spinoza.

With respect to the principle from which these important consequences were deduced, it is observable, that it is stated by Leibnitz in terms so general and vague, as to extend to all the different departments of our knowledge; for he tells us, that there must be a

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[1] See Note (I.)

[2] The following comment on this part of the Leibnitzian system is from the pen of one of his greatest admirers, *Charles Bonnet*: " Cette Métaphysique transcendante deviendra un peu plus intelligible, si l'on fait attention, qu'en vertu du principe de la *raison suffisante*, tout est nécessairement lié dans l'univers. Toutes les Actions des Etres Simples sont harmoniques, ou subordonnées les unes aux autres. L'exercice actuel de l'activite d'une monade donnée, est determiné par l'exercice actuel de l'activité des monades aux-quelles elle correspond immédiatement. Cette correspondance continue d'un point quelconque de l'univers jusqu'à ses extremités. Représentez-vous les ordres circulaires et concentriques qu'une pierre excite dans une eau dormante: Elles vont toujours en s'élargissant et en s'affoiblissant.

" Mais, l'état actuel d'une monade est nécessairement determiné par son état antécédent: Celui-ci par un état qui a precédé, et ainsi en remontant jusqu'à l'instant de la creation.

* * * *

" Ainsi le passé, le présent, et le futur ne forment dans la même monade qu'une seul chaine. Notre philosophe disoit ingénieusement que *le présent est toujours gros de l'avenir*.

" Il disoit encore que l'Eternel Geómetre resolvoit sans cesse ce Problême; l'état d'une monade étant donné, en déterminer l'état passé présent, et futur de tout l'univers." (*Bonnet*, Tom. VIII. p. 303, 304, 305.)

sufficient reason for every *existence*, for every *event*, and for every *truth*. This use of the word *reason* is so extremely equivocal, that it is quite impossible to annex any precise idea to the proposition. Of this it is unnecessary to produce any other proof than the application which is here made of it to things so very different as *existences*, *events*, and *truths*; in all of which cases, it must of necessity have different meanings. It would be a vain attempt, therefore, to combat the maxim in the form in which it is commonly appealed to: Nor, indeed, can we either adopt or reject it, without considering particularly how far it holds in the various instances to which it may be applied.

The multifarious discussions, however, of a physical, a metaphysical, and a theological nature,[1] necessarily involved in so detailed an examination, would, in the present times (even if this were a proper place for introducing them), be equally useless and uninteresting; the peculiar opinions of Leibnitz on most questions connected with these sciences having already fallen into complete neglect. But as the maxim still continues to be quoted by the latest advocates for the scheme of necessity, it may not be altogether superfluous to observe, that, when understood to refer to the changes that take place in the *material* universe, it coincides entirely with the common maxim, that "every change implies the operation of a *cause*;" and that it is in consequence of its intuitive evidence in this particular case, that so many have been led to acquiesce in it, in the unlimited terms in which Leibnitz has announced it. One thing will be readily granted, that the maxim, when applied to the determinations of intelligent and moral *agents*, is not *quite* so obvious and indisputable, as when applied to the changes that take place in things altogether inanimate and passive.

What then, it may be asked, induced Leibnitz, in the enunciation of his maxim, to depart from the form in which it has generally been stated, and to substitute, instead of the word *cause*, the word *reason*, which is certainly not only the more unusual, but the more ambiguous expression of the two? Was it not evidently a perception of the impropriety of calling the motives from which we act the *causes* of our actions; or, at least of the inconsistency of this language with the common ideas and feelings of mankind? The word *rea-*

[1] Since the time of Leibnitz, the principle of the *sufficient reason* has been adopted by some mathematicians as a legitimate mode of reasoning in plane geometry; in which case, the application made of it has been, in general, just and logical, notwithstanding the vague and loose manner in which it is expressed. In this science, however, the use of it can never be attended with much advantage; except perhaps in demonstrating a few elementary truths (such as the 5th and 6th propositions of Euclid's first book), which are commonly established by a more circuitous process: And, even in these instances, the spirit of the reasoning might easily be preserved under a different form, much less exceptionable in point of phraseology.

son is *here* much less suspicious, and much more likely to pass current without examination. It was therefore with no small dexterity, that Leibnitz contrived to express his general principle in such a manner, that the impropriety of his language should be most apparent in that case in which the proposition is instantaneously admitted by every reader as self-evident; and to adapt it, in its most precise and definite shape, to the case in which it was in the greatest danger of undergoing a severe scrutiny. In this respect, he has managed his argument with more address than Collins, or Edwards, or Hume, all of whom have applied the maxim to *mind*, in the very same words in which it is usually applied to inanimate matter.

But on this article of Leibnitz's philosophy, which gave occasion to his celebrated controversy with Clarke, I shall have a more convenient opportunity to offer some strictures when I come to take notice of another antagonist, more formidable still, whom Clarke had soon after to contend with on the same ground. The person I allude to is Anthony Collins; a writer certainly not once to be compared with Leibnitz, in the grasp of his intellectual powers; but who seems to have studied this particular question with greater attention and accuracy, and who is universally allowed to have defended his opinions concerning it in a manner far more likely to mislead the opinions of the multitude.

II. The same remark which has been already made on the principle of the *Sufficient Reason* may be extended to that of the *Law of Continuity*. In both instances the phraseology is so indeterminate, that it may be interpreted in various senses essentially different from each other; and, accordingly, it would be idle to argue against either principle as a general theorem, without attending separately to the specialties of the manifold cases which it may be understood to comprehend. Where such a latitude is taken in the enunciation of a proposition, which, so far as it is true, must have been inferred from an induction of particulars, it is at least possible that, while it holds in *some* of its applications, it may yet be far from possessing any claim to that universality which seems necessarily to belong to it, when considered in the light of a metaphysical axiom, resting on its own intrinsic evidence.

Whether this vagueness of language was the effect of artifice, or of a real vagueness in the author's notions, may perhaps be doubted; but that it has contributed greatly to extend his reputation among a very numerous class of readers, may be confidently asserted. The possession of a general maxim, sanctioned by the authority of an illustrious name, and in which, as in those of the schoolmen, *more* seems to *be meant than meets the ear*, affords of itself no slight gratification to the vanity of many; nor is it inconvenient for a disputant, that the maxims to which he is to appeal should be stated in so dubious a shape, as to en-

able him, when pressed in an argument, to shift his ground at pleasure, from one interpretation to another. The extraordinary popularity which, in our own times, the philosophy of Kant enjoyed, for a few years, among the countrymen of Leibnitz, may, in like manner, be in a great degree ascribed to the imposing aspect of his enigmatical oracles, and to the consequent facility of arguing without end, in defence of a system to transmutable and so elusive in its forms.

The extension, however, given to the *Law of Continuity*, in the later publications of Leibnitz, and still more by some of his successors, has been far greater than there is any reason to think was originally in the author's contemplation. It first occurred to him in the course of one of his physical controversies, and was probably suggested by the beautiful exemplifications of it which occur in pure geometry. At that time it does not appear that he had the slightest idea of its being susceptible of any application to the objects of natural history; far less to the succession of events in the intellectual and moral worlds. The supposition of bodies *perfectly hard*, having been shown to be inconsistent with two of his leading doctrines, *that* of the constant maintenance of the same quantity of force in the Universe, and *that* of the proportionality of forces to the squares of the velocities,—he found himself reduced to the necessity of asserting, that all changes are produced by insensible gradations, so as to render it impossible for a body to have its state changed from motion to rest, or from rest to motion, without passing through all the intermediate states of velocity. From this assumption he argued, with much ingenuity, that the existence of atoms, or of perfectly hard bodies, is impossible; because, if two of them should meet with equal and opposite motions, they would necessarily stop at once, in violation of the *law of continuity*. It would, perhaps, have been still more logical, had he argued against the universality of a law so gratuitously assumed, from its incompatibility with an hypothesis, which, whether true or false, certainly involves nothing either contradictory or improbable: but as this inversion of the argument would have undermined some of the fundamental principles of his physical system, he chose rather to adopt the other alternative, and to announce the *law of continuity* as a metaphysical truth, which admitted of no exception whatever. The facility with which this *law* has been adopted by subsequent philosophers is not easily explicable; more especially, as it has been maintained by many who reject those physical errors, in defence of which Leibnitz was first led to advance it.

One of the earliest, and certainly the most illustrious, of all the partizans and defenders of this principle, was John Bernouilli, whose discourse on motion first appeared at Paris in 1727, having been previously communicated to the Royal Academy of Sciences, in

1724 and 1726.[1] It was from this period it began to attract the general attention of the learned; although many years were yet to elapse, before it was to acquire that authority which it now possesses among our most eminent mathematicians.

Mr Maclaurin, whose Memoir on the *Percussion of Bodies* gained the prize from the Royal Academy of Sciences, in 1724, continued from that time, till his death, the steady opposer of this new *law*. In his treatise of *Fluxions*, published in 1742, he observes, that " the existence of hard bodies void of elasticity has been rejected for the sake of what is called the *Law of Continuity*; a law which has been *supposed* to be general, without sufficient ground."[2] And still more explicitly, in his *Posthumous Account of Newton's Philosophical Discoveries*, he complains of those who " have rejected hard bodies as impossible, from far-fetched and metaphysical considerations;" proposing to his adversaries this unanswerable question, " Upon what grounds is the *law of continuity* assumed as an universal law of nature?"[3]

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[1] " En effet (says Bernouilli), un pareil principe de dureté (the supposition to wit of bodies perfectly hard) ne sçauroit exister; c'est une chimere qui répugne a cette loi générale que la nature observe constamment dans toutes ses opérations; je parle de cet ordre immuable et perpétuel etabli depuis la creation de l'univers, *qu'on peut appeller* LOI DE CONTINUITÉ, en vertu de laquelle tout ce qui s'exécute, s'exécute par des degrés infiniment petits. Il semble que le bon sens dicte, qu'aucun changement ne peut se faire *par saut; natura non operatur per saltum;* rien ne peut passer d'une extremité à l'autre, sans passer par tous les degrés du milieu," &c. The continuation of this passage (which I have not room to quote) is curious, as it suggests an argument, in proof of the *law of continuity*, from the principle of the *sufficient reason.*

It may be worth while to observe here, that though, in the above quotation, Bernouilli speaks of the *law of continuity* as an arbitrary arrangement of the Creator, he represents in the preceding paragraph, the idea of perfectly hard bodies, as involving a manifest contradiction.

[2] Maclaurin's *Fluxions*, Vol. II. p. 438.

[3] Nearly to the same purpose Mr Robins, a mathematician and philosopher of the highest eminence, expresses himself thus: " M. Bernoulli (in his *Discours sur les Lois de la Communication du Mouvement*), in order to prove that there are no bodies perfectly hard and inflexible, lays it down as an immutable law of nature, that no body can pass from motion to rest instantaneously, or without having its velocity gradually diminished. That this is a law of nature, M. Bernouilli thinks is evident from that principle, *Natura non operatur per saltum*, and from good sense. BUT HOW GOOD SENSE CAN, OF ITSELF, WITHOUT EXPERIMENT, DETERMINE ANY OF THE LAWS OF NATURE, IS TO ME VERY ASTONISHING. Indeed, from any thing M. Bernouilli has said, it would have been altogether as conclusive to have begun at the other end, and have disputed, that no body can pass instantaneously from motion to rest; because it is an immutable law of nature that all bodies shall be flexible." (Robins, Vol. II. p. 171, 175.)

In quoting these passages, I would not wish to be understood as calling in question the universality of the *Law of Continuity* in the phenomena of moving bodies; a point on which I am not led by the subject of this discourse to offer any opinion, but on which I intend to hazard some remarks in a Note at the end of it. See Note (K.) All that I would here assert is, that it is a *law* the truth of which can be inferred only by an induction from the phenomena; and to which, accordingly, we are not entitled to say that there cannot possibly exist any exceptions.

In the speculations hitherto mentioned, the *law of continuity* is applied merely to such *successive* events in the material world as are connected together by the relation of *cause and effect*; and, indeed, *chiefly* to the changes which take place in the state of bodies with respect to *motion and rest*. But in the philosophy of Leibnitz, we find the same *law* appealed to as an indisputable principle in all its various researches, physical, metaphysical, and theological. He extends it with the same confidence to mind as to matter, urging it as a demonstrative proof, in opposition to Locke, that the soul never ceases to think even in sleep or in a *deliquium*;[1] nay, inferring from it the impossibility that, in the case of any animated being, there should be such a thing as *death*, in the literal sense of that word.[2] It is by no means probable that the author was at all aware, when he first introduced this principle into the theory of motion, how far it was to lead him in his researches concerning other questions of greater moment; nor does it appear that it attracted much notice from the learned, but as a new *mechanical* axiom, till a considerable time after his death.

Charles Bonnet of Geneva, a man of unquestionable talents and of most exemplary worth, was, as far as I know, the first who entered fully into the views of Leibnitz on this point; perceiving how inseparably the law of continuity (as well as the principle of the sufficient reason) was interwoven with his scheme of universal concatenation and mechanism; and inferring from thence not only all the paradoxical corollaries deduced from it by its author, but some equally bold conclusions of his own, which Leibnitz either did not foresee in their full extent, or to which the course of his inquiries did not particularly attract his attention. The most remarkable of these conclusions was, that all the various beings which compose the universe, form a scale descending downwards without any chasm or *saltus*, from the Deity to the simplest forms of unorganised matter;[3] a proposi-

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[1] "Je tiens que l'âme, et même le corps, n'est jamais sans action, et que l'âme n'est jamais sans quelque perception, même en dormant, on a quelque sentiment confus et sombre du lieu où l'on est, et d'autres choses. *Mais quand l'expérience ne le confirmeroit pas, je crois qu'il y en a démonstration.* C'est à peu pres comme on ne sauroit prouver absolument par les expériences, s'il n'y a point de vuide dans l'espace, et s'il n'y a point de repos dans la matière. Et cependant ces questions me paroissent decidées démonstrativement aussi bien qu'à M. Locke." (Leib. *Op.* Tome II. p. 220.)

[2] See Note (L.)

[3] "Leibnitz admettoit comme un principe fondamental de sa sublime philosophie, qu'il n'y a jamais de sauts dans la nature, et que tout est continu ou nuancé dans le physique et dans le moral. C'etoit sa fameuse *Loi de Continuité*, qu'il croyoit retrouver encore dans les mathématiques, et çavoit été cette loi qui lui avoit inspiré la singuliere prédiction dont je parlois."* "Tous les êtres, disoit il, ne forment qu'une seule chaine, dans laquelle les differentes classes, comme autant d'anneaux, tiennent si étroitement les unes aux autres, qu'il est impossible aux sens et à l'imagination de fixer précisément le point ou quelqu'une com-

* La prediction de la decouverte des Polypes.

tion not altogether new in the history of philosophy, but which I do not know that any writer before Bonnet had ventured to assert as a metaphysical and necessary truth. With what important limitations and exceptions it must be received, even when confined to the comparative anatomy of animals, has been fully demonstrated by Cuvier;[1] and it is of material consequence to remark, that these exceptions, how few soever, to a *metaphysical* principle, are not less fatal to its truth than if they exceeded in number the instances which are quoted in support of the general rule.[2]

At a period somewhat later, an attempt has been made to connect the *same law of continuity* with the history of human improvement, and more particularly with the progress of invention in the sciences and arts. Helvetius is the most noted writer in whom I have observed this last extension of the Leibnitzian principle; and I have little doubt, from his

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mence ou finit: toutes les especes qui bordent ou qui occupent, pour ainsi dire, les régions d'inflection, et de rebroussement, devoit etre équivoques et douees de caractères qui peuvent se rapporter aux espèces voisins également. Ainsi, l'existence des zoophytes ou *Plant-Animaux* n'a rien de monstrueux; mais il est même convenable l'ordre de la nature qu'il y en ait. Et telle est la force du principe de continuité chez moi, que non seulement je ne serois point étonné d'apprendre, qu'on eut trouvé des êtres, qui par rapport à plusieurs propriétés, par exemple, celle de se nourrir ou de se multiplier, puissent passer pour des végétaux à aussi bon droit que pour des animaux, . . . J'en serois si peu étonné dis-je, que même je suis convaincu qu'il doit y en avoir de tels, que l'Histoire Naturelle parviendra peut-être à connoître un jour," &c. &c. (*Contemplation de la Nature*, pp. 341, 342.)

Bonnet, in the sequel of this passage, speaks of the words of Leibnitz, as a prediction of the discovery of the *Polypus*, deduced from the *Metaphysical* principle of the Law of Continuity. But would it not be more philosophical to regard it as a query founded on the *analogy* of nature, as made known to us by experience and observation?

[1] *Leçons d'Anatomie Comparée.*

[2] While Bonnet was thus employing his ingenuity in generalizing, still farther than his predecessors had done, the law of continuity, one of the most distinguished of his fellow citizens, with whom he appears to have been connected in the closest and most confidential friendship (the very ingenious M. Le Sage), was led, in the course of his researches concerning the physical cause of gravitation, to deny the existence of the law, even in the descent of heavy bodies. "The action of gravity (according to him) is *not* continuous." In other words, "each of its impressions is finite; and the interval of time which separates it from the following impression is of a finite duration." Of this proposition he offers a proof, which he considers as demonstrative; and thence deduces the following very paradoxical corollary, That "Projectiles do not move in curvilinear paths, but in rectilinear polygons."—"C'est ainsi (he adds) qu'un prés, qui vû de près, se trouve couvert de parties vertes réellement separées, offre cependant aux personnes qui le regardent de loin, la sensation d'une verdure continué: Et qu'un corps poli, auquel le microscope deconvre mille solutions de continuité, paroit a l'oeil nu, posséder une continuité parfaite."

"Généralement, le simple bon sens, qui veut, qu'on suspende son jugement sur ce qu'on ignore, et que l'on ne tranche pas hardiment sur la non-existence de ce qui echappe à nos sens, auroit dû empêcher des gens qui s'appeloient philosophes de decider si dogmatiquement, la continuite ré lle, de ce qui avoit une continuité apparente; et la non-existence des intervalles qu'ils n'apercevoient pas." (*Essai de Chymie Mécanique*. Couronne en 1758, par l'Académie de Rouen; Imprime à Geneve, 1761. pp. 94, 95, 96.)

known opinions, that, when it occurred to him, he conceived it to afford a new illustration of the scheme of necessity, and of the mechanical concatenation of all the phenomena of human life. Arguing in support of his favourite paradox concerning the original equality of all men in point of mental capacity, he represents the successive advances made by different individuals in the career of discovery, as so many imperceptible or infinitesimal steps, each individual surpassing his predecessor by a trifle, till at length nothing is wanting but an additional mind (not superior to the others in natural powers) to combine together, and to turn to its own account, their accumulated labours. "It is upon *this* mind," he observes, "that the world is always ready to bestow the attribute of genius. From the tragedies of *The Passion*, to the poets Hardy and Rotrou, and to the *Mariamne* of Tristan, the French theatre was always acquiring successively an infinite number of inconsiderable improvements. Corneille was born at a moment, when the addition he made to the art could not fail to form an epoch; and accordingly Corneille is universally regarded as a Genius. I am far from wishing," Helvetius adds, "to detract from the glory of this great poet. I wish only to prove, that *Nature never proceeds* PER SALTUM, *and that the Law of Continuity is always exactly observed.* The remarks, therefore, now made on the dramatic art, may also be applied to the sciences which rest on observation."[1] (*De l'Esprit,* Dis. IV. Chap. 1.)

With this last extension of the *Law of Continuity*, as well as with that of Bonnet, a careless reader is the more apt to be dazzled, as there is a large mixture in both of unquestionable truth. The mistake of the ingenious writers lay in pushing to *extreme cases* a doctrine, which, when kept within certain limits, is not only solid but important; a mode of reasoning, which, although it may be always safely followed out in pure Mathematics (where the principles on which we proceed are mere definitions), is a never-failing source

[1] It may, perhaps, be alleged, that the above allusion to the *Law of Continuity* was introduced merely for the sake of illustration, and that the author did not mean his words to be strictly interpreted; but this remark will not be made by those who are acquainted with the philosophy of Helvetius.

Let me add, that, in selecting Corneille as the only exemplification of this theory, Helvetius has been singularly unfortunate. It would have been difficult to have named any other modern poet, in whose works, when compared with those of his immediate predecessors, the *Law of Continuity* has been more remarkably violated. "Corneille (says a most judicious French critic) est, pour ainsi dire, de notre tems; mais ses contemporains n'en sont pas. *Le Cid, les Horaces, Cinna, Policucte,* forment le commencement de cette chaine brillante qui réunit notre litterature actuelle de celle du règne de Richelieu et de la minorité de Louis XIV.; mais autour de ces points lumineux règne encore une nuit profonde; leur éclat les rapproche en apparence de nos yeux; le reste, repoussé dans l'obscurité, semble bient loin de nous. Pour nous Corneille est moderne, et Rotrou ancien," &c. (For detailed illustrations and proofs of these positions, see a slight but masterly historical sketch of the French Theatre, by M. Suard.)

of error in all the other sciences; and which, when practically applied to the concerns of life, may be regarded as an infallible symptom of an understanding better fitted for the subtle contentions of the schools, than for those average estimates of what is expedient and practicable in the conduct of affairs, which form the chief elements of political sagacity and of moral wisdom.[1]

If on these two celebrated principles of Leibnitz, I have enlarged at greater length than may appear to some of my readers to be necessary, I must remind them, 1*st*, Of the illustration they afford of what Locke has so forcibly urged with respect to the danger of adopting, upon the faith of reasonings *a priori*, metaphysical conclusions concerning the laws by which the universe is governed: 2*dly*, Of the proof they exhibit of the strong bias of the human mind, even in the present advanced stage of experimental knowledge, to grasp at general maxims, without a careful examination of the grounds on which they rest; and of that less frequent, but not less unfortunate bias, which has led some of our most eminent mathematicians to transfer to sciences, resting ultimately on an appeal to *facts*, those habits of thinking which have been formed amidst the hypothetical abstractions of pure geometry: *Lastly*, Of the light they throw on the mighty influence which the name and authority of Leibnitz has, for more than a century past, exercised over the strongest and acutest understandings in the most enlightened countries of Europe.

It would be improper to close these reflections on the philosophical speculations of Leibnitz, without taking some notice of his very ingenious and original thoughts on the etymological study of languages, considered as a guide to our conclusions concerning the origin and migrations of different tribes of our species. These thoughts were published in 1710, in the *Memoirs* of the Berlin Academy; and from the first article of the first

[1] Locke has fallen into a train of thought very similar to that of Bonnet, concerning the *Scale of Beings*; but has expressed himself with far greater caution;—stating it modestly as an inference deduced from an induction of particulars, not as the result of any abstract or metaphysical principle. (See Locke's *Works*, Vol. III. p. 101.) In one instance, indeed, he avails himself of an allusion, which, at first sight, may appear to favour the extension of the mathematical *Law of Continuity* to the works of creation; but it is evident, from the context, that he meant this allusion merely as a popular illustration of a fact in Natural History; not as the rigorous enunciation of a theorem applicable alike to all truths, mathematical, physical, and moral. "It is a hard matter to say where sensible and rational begin, and where insensible and irrational end; and who is there quick-sighted enough to determine precisely, which is the lowest species of living things, and which is the first of those who have no life? Things, as far as we can observe, lessen and augment, as the quantity does in a *regular cone*, where, though there be a manifest odds betwixt the bigness of the diameter at a remote distance, yet the difference between the upper and under, where they touch one another, is hardly discernible." (*Ibid.*)

See some Reflections on this speculation of Locke's in the *Spectator*, No. 519.

volume of that justly celebrated collection. I do not recollect any author of an earlier date, who seems to have been completely aware of the important consequences to which the prosecution of this inquiry is likely to lead; nor, indeed, was much progress made in it by any of Leibnitz's successors, till towards the end of the last century; when it became a favourite object of pursuit to some very learned and ingenious men, both in France, Germany, and England. *Now*, however, when our knowledge of the globe, and of its inhabitants, is so wonderfully enlarged by commerce, and by conquest; and when so great advances have been made in the acquisition of languages, the names of which, till very lately, were unheard of in this quarter of the world;—there is every reason to hope for a series of farther discoveries, strengthening progressively, by the multiplication of their mutual points of contact, the common evidence of their joint results; and tending more and more to dissipate the darkness in which the primeval history of our race is involved. It is a field, of which only detached corners have hitherto been explored; and in which, it may be confidently presumed, that unthought of treasures still lie hid, to reward sooner or later the researches of our posterity.[1]

My present subject does not lead me to speak of the mathematical and physical researches, which have associated so closely the name of Leibnitz with that of Newton, in the history of modern science; of the inexhaustible treasures of his erudition, both classical and scholastic; of his vast and manifold contributions towards the elucidation of German antiquities and of Roman jurisprudence; or of those theological controversies, in which, while he combated with one hand the enemies of revelation, he defended, with the other, the orthodoxy of his own dogmas against the profoundest and most learned divines of Europe. Nor would I have digressed so far as to allude here to these particulars, were it not for the unparalleled example they display, of what a vigorous and versatile genius, seconded by habits of persevering industry, may accomplish, within the short span of human life. Even the relaxations with which he was accustomed to fill up his moments of leisure, partook of the general character of his more serious engagements. By early and long habit, he had acquired a singular facility in the composition of Latin verses; and he seems to have delighted in loading his muse with new fetters of his own contrivance, in addition to those imposed by the laws of classical prosody.[2] The number, besides, of his literary correspondents

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[1] See Note (M.)

[2] A remarkable instance of this is mentioned by himself in one of his letters. "Annos natus tredecim una die trecentos versus hexametros effudi, sine elisione omnes, quod hoc fieri facilè posse fortè affirmassem." (Leib. *Op.* Tom. V. p. 304.) He also amused himself occasionally with writing verses in German and in French.

was immense; including all that was most illustrious in Europe: and the rich materials everywhere scattered over his letters are sufficient of themselves to show, that his amusements consisted rather in a change of objects, than in a suspension of his mental activity. Yet while we admire these stupendous monuments of his intellectual energy, we must not forget (if I may borrow the language of Gibbon) that "even the powers of Leibnitz were dissipated by the multiplicity of his pursuits. He attempted more than he could finish; he designed more than he could execute; his imagination was too easily satisfied with a bold and rapid glance on the subject which he was impatient to leave; and he may be compared to those heroes whose empire has been lost in the ambition of universal conquest."[1]

From some expressions which Leibnitz has occasionally dropped, I think it probable, that he himself became sensible, as he advanced in life, that his time might have been more profitably employed, had his studies been more confined in their aim. "If the whole earth (he has observed on one occasion) had continued to be of one language and of one speech, human life might be considered as extended beyond its present term, by the addition of all that part of it which is devoted to the acquisition of dead and foreign tongues. Many other branches of knowledge, too, may, in this respect, be classed with the languages; such as Positive Laws, Ceremonies, the Styles of Courts, and a great proportion of what is called *critical erudition*. The utility of all these arises merely from opinion; nor is there to be found, in the innumerable volumes that have been written to illustrate them, a hundredth part, which contains anything subservient to the happiness or improvement of mankind."

The most instructive lesson, however, to be drawn from the history of Leibnitz, is the incompetency of the most splendid gifts of the understanding, to advance essentially the interests either of metaphysical or of Ethical Science, unless accompanied with that rare devotion to truth, which may be regarded, if not as the basis, at least as one of the most indispensable elements, of moral genius. The chief attraction to the study of philosophy, in *his* mind, seems to have been (what many French critics have considered as a chief source of the charms of the imitative arts) the pride of *conquering difficulties:* a feature of his character which he had probably in his own eye, when he remarked (not without some degree of conscious vanity), as a peculiarity in the turn or cast of his intellect, that to *him* "all difficult

[1] May I presume to remark farther, that the native powers of Leibnitz's mind, astonishing and preternatural as they certainly were, seem sometimes oppressed and overlaid under the weight of his still more astonishing erudition? The influence of his scholastic reading is more peculiarly apparent in warping his judgment, and clouding his reason, on all questions connected with Metaphysical Theology.

things were easy, and all easy things difficult."[1] Hence the disregard manifested in his writings to the simple and obvious conclusions of experience and common sense; and the perpetual effort to unriddle mysteries over which an impenetrable veil is drawn. "Scilicet sublime et erectum ingenium pulchritudinem ac speciem excelsæ magnæque gloriæ vehementius quam caute appetebat." It is to be regretted that the sequel of this fine eulogy does not equally apply to him. "Mox mitigavit ratio et ætas; *retinuitque, quod est difficillimum, et in sapientia modum*."[2] How happily does this last expression characterize the temperate wisdom of Locke, when contrasted with that towering, but impotent ambition, which, in the Theories of Optimism and of Pre-established Harmony, seemed to realize the fabled revolt of the giants against the sovereignty of the gods!

After all, a similarity may be traced between these two great men in *one* intellectual weakness common to both; a facility in the admission of facts, stamped sufficiently (as we should *now* think) by their own intrinsic evidence, with the marks of incredibility. The observation has been often made with respect to Locke; but it would be difficult to find in Locke's writings, any thing so absurd as an account gravely transmitted by Leibnitz to the Abbé de St Pierre, and by him communicated to the Royal Academy of Sciences at Paris, of a dog who spoke.[3] No person liberally educated could, I believe, be found at present in any *Protestant* country of Christendom, capable of such credulity. By what causes so extraordinary a revolution in the minds of men has been effected, within the short space of a hundred years, I must not here stop to inquire. Much, I apprehend, must be ascribed to our enlarged knowledge of nature, and more particularly to those scientific voyages and travels which have annihilated so many of the prodigies which exercised the wonder and subdued the reason of our ancestors. But, in whatever manner the revolution is to be explained, there can be no doubt that this growing disposition to weigh scrupulously the *probability* of alleged *facts* against the faith due to the testimonies brought to attest them, and, even in some cases, against the apparent evidence of our own senses, enters largely and essentially into the composition of that philosophical *spirit* or temper, which so strongly distinguishes the eighteenth century from all those which preceded it.[4] It is no small consolation to reflect, that some important maxims of good sense have been thus familiarized to the most ordinary understandings, which, at so very recent a period, failed in producing their due effect on two of the most powerful minds in Europe.

[1] "Sentio paucos esse mei characteris, et omnia facilia mihi difficilia, omnia contra difficilia mihi facilia esse."—Leib. *Op.* Tom. VI. p. 302.

[2] Tacitus, *Agric.*

[3] See Note (N.)

[4] See Note (O.)

On reviewing the foregoing paragraphs, I am almost tempted to retract part of what I have written, when I reflect on the benefits which the world has derived even from the *errors* of Leibnitz. It has been well and justly said, "that every *desideratum* is an imperfect discovery;" to which it may be added, that every new problem which is started, and still more every attempt, however abortive, towards its solution, strikes out a new path, which must sooner or later lead to the truth. If the problem be solvible, a solution will in due time be obtained: If insolvible, it will soon be abandoned as hopeless by general consent; and the legitimate field of scientific research will become more fertile, in proportion as a more accurate survey of its boundaries adapts it better to the limited resources of the cultivators.

In this point of view, what individual in modern times can be compared to Leibnitz! To how many of those researches, which still usefully employ the talents and industry of the learned, did he not point out and open the way! From how many more did he not warn the wise to withhold their curiosity, by his bold and fruitless attempts to burst the barriers of the invisible world!

The best *eloge* of Leibnitz is furnished by the literary history of the eighteenth century;—a history which, whoever takes the pains to compare with his works, and with his epistolary correspondence, will find reason to doubt whether, at the singular era when he appeared, he could have more accelerated the advancement of knowledge by the concentration of his studies, than he has actually done by the universality of his aims; and whether he does not afford one of the few instances to which the words of the poet may literally be applied:

"Si non errasset, fecerat ille minus."[1]

SECTION III.

Of the Metaphysical Speculations of Newton and Clarke.—Digression with respect to the System of Spinoza.—Collins and Jonathan Edwards.—Anxiety of both to reconcile the Scheme of Necessity with Man's Moral Agency.—Departure of some later Necessitarians from their views.[2]

The foregoing review of the philosophical writings of Locke and of Leibnitz naturally leads our attention, in the next place, to those of our illustrious countrymen Newton and

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[1] See Note (P.)

[2] In conformity to the plan announced in the preface to this *Dissertation*, I confine myself to those authors whose opinions have had a marked and general influence on the subsequent history of philosophy;

Clarke; the former of whom has exhibited, in his *Principia* and *Optics*, the most perfect exemplifications which have yet appeared, of the cautious logic recommended by Bacon and Locke; while the other, in defending against the assaults of Leibnitz the metaphysical principles on which the Newtonian philosophy proceeds, has been led, at the same time, to vindicate the authority of various other truths, of still higher importance, and more general interest.

The chief subjects of dispute between Leibnitz and Clarke, so far as the principles of the Newtonian philosophy are concerned, have been long ago settled, to the entire satisfaction of the learned world. The *monads*, and the *plenum*, and the *pre-established harmony* of Leibnitz, already rank, in the public estimation, with the vortices of Descartes, and the plastic nature of Cudworth; while the theory of gravitation prevails everywhere over all opposition; and (as Mr. Smith remarks) "has advanced to the acquisition of the most universal empire that was ever established in philosophy." On these points, therefore, I have only to refer my readers to the collection published by Dr Clarke, in 1717, of the controversial papers which passed between him and Leibnitz during the two preceding years; a correspondence equally curious and instructive; and which, it is to be lamented, that the death of Leibnitz in 1716 prevented from being longer continued.[1]

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passing over a multitude of other names well worthy to be recorded in the annals of metaphysical science. Among these, I shall only mention the name of Boyle, to whom the world is indebted, beside some very acute remarks and many fine illustrations of his own upon metaphysical questions of the highest moment, for the philosophical arguments in defence of religion, which have added so much lustre to the names of Derham and Bentley; and far above both, to that of Clarke.* The *remarks* and *illustrations*, which I here refer to, are to be found in his *Inquiry into the Vulgar Notion of Nature*, and in his *Essay, inquiring whether, and how, a Naturalist should consider Final Causes.* Both of these tracts display powers which might have placed their author on a level with Descartes and Locke, had not his taste and inclination determined him more strongly to other pursuits. I am inclined to think, that neither of them is so well known as were to be wished. I do not even recollect to have seen it anywhere noticed, that some of the most striking and beautiful instances of design in the order of the material world, which occur in the Sermons preached at Boyle's *Lecture*, are borrowed from the works of the founder. †

Notwithstanding, however, these great merits, he has written too little on such abstract subjects to entitle him to a place among English metaphysicians; nor has he, like Newton, started any leading thoughts which have since given a new direction to the studies of metaphysical inquirers. From the slight specimens he has left, there is reason to conclude, that his mind was still more happily turned than that of Newton, for the prosecution of that branch of science to which their contemporary Locke was then beginning to invite the attention of the public.

[1] From a letter of Leibnitz to M. Remond de Montmort, it appears that he considered Newton, and not

* To the English reader it is unnecessary to observe, that I allude to the Sermons preached at the Lecture founded by the Honourable Robert Boyle.

† Those instances, more especially, which are drawn from the anatomical structure of animals, and the adaptation of their perceptive organs to the habits of life for which they are destined.

Although Newton does not appear to have devoted much of his time to Metaphysical researches, yet the general spirit of his physical investigations has had a great, though indirect, influence on the metaphysical studies of his successors. It is justly and profoundly remarked by Mr Hume, that "while Newton *seemed* to draw off the veil from some of the mysteries of nature, he showed, at the same time, the imperfections of the mechanical philosophy, and thereby restored her ultimate secrets to that obscurity in which they ever did, and ever will remain." In this way, his discoveries have co-operated powerfully with the reasonings of Locke in producing a general conviction of the inadequacy of our faculties to unriddle those sublime enigmas on which Descartes, Malebranche, and Leibnitz, had so recently wasted their strength, and which, in the ancient world, were regarded as the only fit objects of philosophical curiosity. It is chiefly too since the time of Newton that the ontology and pneumatology of the dark ages have been abandoned for inquiries resting on the solid basis of experience and analogy; and that philosophers have felt themselves emboldened by his astonishing discoveries concerning the more distant parts of the material universe, to argue from the known to the unknown parts of the moral world. So completely has the prediction been verified which he himself hazarded, in the form of a query, at the end of his *Optics*, that "if natural philosophy should continue to be improved in its various branches, the bounds of moral philosophy would be enlarged also."

How far the peculiar cast of Newton's genius qualified him for prosecuting successfully the study of Mind, he has not afforded us sufficient *data* for judging; but such was the admiration with which his transcendent powers as a Mathematician and Natural Philosopher were universally regarded, that the slightest of his hints on other subjects have been eagerly seized upon as indisputable axioms, though sometimes with little other evidence in their favour but the supposed sanction of his authority.[1] The part of his works, however, which chiefly led me to connect his name with that of Clarke, is a passage in the

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Clarke, as his real antagonist in this controversy. "M. Clarke, ou plutôt M. Newton, dont M. Clarke soutient les dogmes, est en dispute avec moi sur la philosophie." (Leib. *Op.* Tom. V. p. 33.) From another letter to the same correspondent we learn, that Leibnitz aimed at nothing less than the complete overthrow of the Newtonian philosophy; and that it was chiefly to his grand principle of the *sufficient reason* that he trusted for the accomplishment of this object. "J'ai reduit l'état de notre dispute à ce grand axiome, que *rien n'existe ou n'arrive sans qu'il y ait une raison suffisante, pourquoi il en est plutôt ainsi qu'autrement.* S'il continue à me le nier, où en sera sa sincerité? S'il me l'accorde, adieu le vuide, les atomes, *et toute la philosophie de M. Newton.*" (Ibid.) See also a letter from Leibnitz to M. des Maizeaux in the same volume of his works, p. 39.

[1] Witness Hartley's *Physiological Theory of the Mind*, founded on a query in Newton's *Optics;* and a long list of theories in medicine, grafted on a hint thrown out in the same query, in the form of a modest conjecture.

Scholium annexed to his *Principia*,[1] which may be considered as the germ of the celebrated argument *a priori* for the existence of God, which is commonly, though, I apprehend, not justly, regarded as the most important of all Clarke's contributions to Metaphysical Philosophy. I shall quote the passage in Newton's own words, to the oracular conciseness of which no English version can do justice.

"Æternus est et infinitus, omnipotens et omnisciens; id est, durat ab æterno in æternum, et adest ab infinito in infinitum.....Non est æternitas et infinitas, sed æternus et infinitus; non est duratio et spatium, sed durat et adest. Durat semper et adest ubique, et existendo semper et ubique durationem et spatium constituit."[2] Proceeding on these

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[1] This *scholium*, it is to be observed, first appeared at the end of the second edition of the *Principia*, printed at Cambridge in 1713. The former edition, published at London in 1687, has no *scholium* annexed to it From a passage, however, in a letter of Newton's to Dr Bentley (dated 1692), its seems probable, that as far back, at least, as that period, he had thoughts of attempting a proof *a priori* of the existence of God. After some new illustrations, drawn from his own discoveries, of the common argument from *final causes*, he thus concludes. "There is yet *another* argument for a Deity, which I take to be a very strong one; but, till the principles on which it is grounded are better received, I think it more advisable to let it sleep." (*Four Letters from Sir I. Newton to Dr Bentley*, p. 11. London, Dodsley, 1756.)

It appears from this passage, that Newton had no intention, like his predecessor Descartes, to supersede, by any new argument of his own for the existence of God, the common one drawn from the consideration of *final causes*; and, therefore, nothing could be more uncandid than the following sarcasm pointed by Pope at the laudable attempts of his two countrymen to *add* to the evidence of this conclusion, by deducing it from *other* principles:

"Let others creep by timid steps and slow,
On plain experience lay foundations low,
By common sense to common knowledge bred,
And last to Nature's cause thro' Nature led:
We nobly take the high *priori*-road,
And reason downwards till we doubt of God."

That Pope had Clarke in his eye when he wrote these lines, will not be doubted by those who recollect the various other occasions in which he has stepped out of his way, to vent an impotent spleen against this excellent person.

"Let Clarke live half his life the poor's support,
But let him live the other half at court."

And again:

"Even in an ornament its place remark;
Nor in a hermitage set Dr Clarke:"

in which last couplet there is a manifest allusion to the bust of Clarke, placed in a hermitage by Queen Caroline, together with those of Newton, Boyle, Locke, and Wollaston. See some fine verses on these busts in a poem called the *Grotto*, by Matthew Green.

[2] Thus translated by Dr Clarke, "God is eternal and infinite, omnipotent and omniscient; that is, he endures from everlasting to everlasting, and is present from infinity to infinity. He is not eternity or infinity, but eternal and infinite. He is not duration or space, but he endures and is present. He endures always, and is present everywhere, and by existing always and everywhere, constitutes duration and space." (See Clarke's *Fourth Reply to Leibnitz*.)

principles, Dr Clarke argued, that, as immensity and eternity (which force themselves irresistibly on our belief as *necessary* existences, or, in other words, as existences of which the annihilation is impossible) are not *substances*, but *attributes*, the immense and eternal Being, whose attributes they are, must exist of necessity also. The existence of God, therefore, according to Clarke, is a truth that follows with demonstrative evidence from those conceptions of space and time which are inseparable from the human mind. . . . . "These (says Dr Reid) are the speculations of men of superior genius; but whether they be as solid as they are sublime, or whether they be the wanderings of imagination in a region beyond the limits of the human understanding, I am at a loss to determine." After this candid acknowledgment from Dr Reid, I need not be ashamed to confess my own doubts and difficulties on the same question.[1]

But although the argument, as stated by Clarke, does not carry complete satisfaction to my mind, I think it must be granted that there is something peculiarly wonderful and overwhelming in those conceptions of immensity and eternity, which it is not less impossible to banish from our thoughts, than the consciousness of our own existence. Nay, further, I think that these conceptions are very intimately connected with the fundamental principles of Natural Religion. For when once we have established, from the evidences of design everywhere manifested around us, the existence of an intelligent and powerful *cause*, we are unavoidably led to apply to this *cause* our conceptions of *immensity* and *eternity*, and to conceive Him as filling the infinite extent of both with his presence and with his power. Hence we associate with the idea of God those awful impressions which are naturally produced by the idea of infinite space, and perhaps still more by the idea of endless duration. Nor is this all. It is from the immensity of space that the notion of infinity is originally derived; and it is hence that we transfer the expression, by a sort of metaphor, to other subjects. When we speak, therefore, of *infinite* power, wisdom, and goodness, our notions, if not wholly borrowed from space, are at least greatly aided by this analogy; so that the conceptions of Immensity and Eternity, if they do not of themselves *demonstrate* the existence of God, yet necessarily enter into the ideas we form of his nature and attributes.

To these various considerations it may be added, that the notion of *necessary existence* which we derive from the contemplation of Space and of Time, renders the same notion,

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[1] An argument substantially the same with this for the existence of God, is hinted at very distinctly by Cudworth, *Intellect. System*, Chap. V. sect. 3, 4. Also by Dr Henry More, *Enchir. Metaph.* Cap. 8. sect. 8. See Mosheim's *Trans. of Cudworth*, Tom. II. p. 356.

when applied to the Supreme Being, much more easy to be apprehended than it would otherwise be.

It is not, therefore, surprising, that Newton and Clarke should have fallen into that train of thought which encouraged them to attempt a demonstration of the being of God from our conceptions of Immensity and Eternity; and still less is it to be wondered at, that, in pursuing this lofty argument, they should have soared into regions where they were lost in the clouds.

I have said above, that Clarke's demonstration seems to have been suggested to him by a passage in Newton's *Scholium*. It is, however, more than probable that he had himself struck into a path very nearly approaching to it, at a much earlier period of his life. The following anecdote of his childhood, related, upon his own authority, by his learned and authentic, though, in many respects, weak and visionary biographer (Whiston), exhibits an interesting example of an anomalous developement of the powers of reflection and abstraction, at an age when, in ordinary cases, the attention is wholly engrossed with sensible objects. Such an inversion of the common process of nature in unfolding our different faculties, is perhaps one of the rarest phenomena in the intellectual world; and, wherever it occurs, may be regarded as strongly symptomatic of something peculiar and decided in the philosophical character of the individual:

"One of his parents," says Whiston, "asked him when he was very young, Whether God could do every thing? He answered, Yes! He was asked again, Whether God could tell a lie? He answered, No! And he understood the question to suppose, that this was the only thing that God could not do; nor durst he say, so young was he then, that he thought there was any thing else which God could not do; while yet, well he remembered, that he had, *even then, a clear conviction in his own mind, that there was one thing which God could not do;—that he could not annihilate that space which was in the room where they were.*"[1]

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[1] The question concerning the necessary existence of Space and of Time formed one of the principal subjects of discussion between Clarke and Leibnitz. According to the former, space and time are, both of them, infinite, immutable, and indestructible. According to his antagonist, "space is nothing but the order of things co-existing," and "time nothing but the order of things successive!" The notion of real absolute Space, in particular, he pronounces to be *a mere chimera and superficial imagination;* classing it with those prejudices which Bacon called *idola tribus*. (See his 4th *Paper*, § 14.)

It has always appeared to me a thing quite inexplicable, that the great majority of philosophers, both in Germany and in France, have, on the above question, decided in favour of Leibnitz. Even D'Alembert himself, who, on most metaphysical points, reasons so justly and so profoundly, has, in this instance, been carried along by the prevailing opinion (or, perhaps, it would be more correct to say, by the fashionable phraseology) among his

With this early and deep impression on his mind, it is easy to conceive how Newton's *Scholium* should have encouraged him to resume the musings of his *boyish days*, concerning the necessary existence of space; and to trace, as far as he could, its connection with the principles of natural theology. But the above anecdote affords a proof how strongly his habits of thought had long before predisposed him for the prosecution of a metaphysical idea, precisely the same with that on which this scholium proceeds.

It would be superfluous to dwell longer on the history of these speculations, which, whatever value they may possess in the opinion of persons accustomed to deep and abstract reasoning, are certainly not well adapted to ordinary or to uncultivated understandings. This consideration furnishes, of itself, no slight presumption, that they were not intended to be the *media* by which the bulk of mankind were to be led to the knowledge of truths so essential to human happiness; and, accordingly, it was on this very ground, that Bishop Butler, and Dr Francis Hutcheson, were induced to strike into a different and more popular path for establishing the fundamental principles of religion and morality. Both of these writers appear to have communicated, in very early youth, their doubts and objections to Dr Clarke; and to have had, even then, a glimpse of those inquiries by which they were afterwards to give so new and so fortunate a direction to the ethical studies of their countrymen. It is sufficient here to remark this circumstance as an important step

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countrymen. " Y auroit-il un espace, s'il n'y avoit point de corps, et une durée s'il n'y avoit rien? Ces questions viennent, ce me semble, de ce qu'on suppose au temps et à l'espace plus de réalité qu'ils n'en ont. . . . . Les enfants, qui disent que le vuide n'est rien, ont raison parce qu'ils s'en tiennent au simples notions du sens commun;* et les philosophes, que veulent réaliser le vuide se perdent dans leurs spéculations: le vuide a été enfanté par les abstractions, et voilà l'abus d'une méthode si utile à bien des égards. *S'il n'y avoit point de corps et de succession, l'espace et le temps seroient possibles, mais ils n'existeroient pas.*" (*Mélanges*, &c. T. V. § xvi.) Bailly, a writer by no means partial to D'Alembert, quotes, with entire approbation, the foregoing observations; subjoining to them, in the following terms, his own judgment on the merits of this branch of the controversy between Clarke and Leibnitz: " La notion du temps et de l'espace, est un des points sur lesquels Leibnitz a combattu contre Clarke; mais il nous semble que l'Anglois n'a rien opposé de satisfaisant aux raisons de Leibnitz." (*Eloge de Leibnitz.*)

As for the point here in dispute, I must own, that it does not seem to me a fit subject for argument: inasmuch as I cannot even form a conception of the proposition contended for by Leibnitz. The light in which the question struck Clarke in his childhood, is the same in which I am still disposed to view it; or rather, I should say, is the light in which I must ever view it, while the frame of my understanding continues unaltered. Of what *data* is human reason possessed, from which it is entitled to argue in opposition to truths, the contrary of which it is impossible not only to prove, but to express in terms comprehensible by our faculties?

For some remarks on the scholastic controversies concerning *space* and *time*, see the First Part of this *Dissertation*, Note I. See also Locke's *Essay*, Book ii. Chap. 13. § § 16, 17, 18.

* I quote the sequel of this passage on the authority of Bailly (see his *Eloge on Leibnitz*), for it is not to be found in the copy of the *Mélanges* before me, printed at Amsterdam in 1767.

in the progress of moral philosophy. The farther illustration of it properly belongs to another part of this discourse.

The chief glory of Clarke, as a metaphysical author, is due to the boldness and ability with which he placed himself in the breach against the Necessitarians and Fatalists of his times. With a mind far inferior to that of Locke, in comprehensiveness, in originality, and in fertility of invention, he was nevertheless the more wary and skilful disputant of the two, possessing, in a singular degree, that reach of thought in grasping remote consequences, which effectually saved him from those rash concessions into which Locke was frequently betrayed by the greater warmth of his temperament, and vivacity of his fancy. This logical foresight (the natural result of his habits of mathematical study) rendered him peculiarly fit to contend with adversaries, eager and qualified to take advantage of every vulnerable point in his doctrines; but it gave, at the same time, to his style a tameness, and monotony, and want of colouring, which never appear in the easy and spirited, though often unfinished and unequal, sketches of Locke. Voltaire has somewhere said of him, that he was a mere reasoning machine (*un moulin à raisonnement*), and the expression (though doubtless much too unqualified) possesses a merit, in point of just discrimination, of which Voltaire was probably not fully aware.[1]

[1] In the extent of his learning, the correctness of his taste, and the depth of his scientific acquirements, Clarke possessed indisputable advantages over Locke; with which advantages he combined another not less important, the systematical steadiness with which his easy fortune and unbroken leisure enabled him to pursue his favourite speculations through the whole course of his life.

On the subject of Free-will, Locke is more indistinct, undecided, and inconsistent, than might have been expected from his powerful mind, when directed to so important a question. This was probably owing to his own strong feelings in favour of man's moral liberty, struggling with the deep impression left on his philosophical creed by the writings of Hobbes, and with his deference for the talents of his own intimate friend, Anthony Collins.* That Locke conceived himself to be an advocate for *free-will*, appears indisputably from many expressions in his Chapter on *Power*; and yet, in that very chapter, he has made various concessions to his adversaries, in which he seems to yield all that was contended for by Hobbes and Collins: And, accordingly, he is ranked, with some appearance of truth, by Priestley, with those who, while they opposed verbally the scheme of necessity, have adopted it substantially, without being aware of their mistake.

In one of Locke's letters to Mr Molyneux, he has stated, in the strongest possible terms, his conviction of man's free agency; resting this conviction entirely on our indisputable consciousness of the *fact*. This declaration of Locke I consider as well worthy of attention in the argument about Free-will; for, although in questions of pure speculation, the authority of great names is entitled to no weight, excepting in so far as it is supported by solid reasoning; the case is otherwise with *facts* relating to the phenomena of the human mind. The patient attention with which Mr Locke had studied these very nice phenomena during the course of a long life, gives to the results of his metaphysical experience a value of the same sort, but much greater in degree, with that which we attach to a delicate experiment in chemistry, when vouched by a Black or a Davy. The ultimate

* See Note (Q.)

I have already taken notice of Clarke's defence of moral liberty in opposition to Leibnitz; but soon after this controversy was brought to a conclusion by the death of his antagonist, he had to resume the same argument, in reply to his countryman, Anthony Collins; who, following the footsteps of Hobbes, with logical talents not inferior to those of his master, and with a weight of personal character in his favour, to which his master had no pretensions;[1] gave to the cause which he so warmly espoused, a degree of credit among sober and serious inquirers, which it had never before possessed in England. I have reserved, therefore, for this place, the few general reflections which I have to offer on this endless subject of controversy. In stating these, I shall be the less anxious to condense my thoughts, as I do not mean to return to the discussion in the sequel of this historical sketch. Indeed, I do not know of anything that has been advanced by later writers, in support of the scheme of necessity, of which the germ is not to be found in the inquiry of Collins.

In order to enter completely into the motives which induced Clarke to take so zealous and so prominent a part in the dispute about Free Will, it is necessary to look back to the system of Spinoza; an author, with whose peculiar opinions I have hitherto avoided to distract my readers' attention. At the time when he wrote, he does not appear to have made

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appeal, after all, must be made by every person to his own consciousness; but when we have the experience of Locke on the one hand, and that of Priestley and Belsham on the other, the contrast is surely sufficient to induce every cautious inquirer to re-examine his feelings before he allows himself to listen to the statements of the latter in preference to that of the former.

For the information of some of my readers, it may be proper to mention that it has of late become fashionable among a certain class of metaphysicians, boldly to assert, that the evidence of *their* consciousness is decidedly in favour of the scheme of necessity.

But to return to Mr Locke. The only consideration on this subject which seems to have staggered him, was the difficulty of reconciling this opinion with the prescience of God. As to this theological difficulty, I have nothing to say at present. The only question which I consider as of any consequence, is the matter of fact; and, on this point, nothing can be more explicit and satisfactory than the words of Locke. In examining these, the attentive reader will be satisfied, that Locke's declaration is not (as Priestley asserts) in favour of the Liberty of Spontaneity, but in favour of the Liberty of Indifference, for, as to the former, there seems to be no difficulty in reconciling it with the prescience of God. "I own (says Mr Locke) freely to you the weakness of my understanding, that though it be unquestionable that there is omnipotence and omniscience in God our Maker, and though *I cannot have a clearer perception of anything than that I am free;* yet I cannot make freedom in man consistent with omnipotence and omniscience in God, though I am as fully persuaded of both as of any truth I most firmly assent to; and therefore I have long since given off the consideration of that question; resolving all into this short conclusion, that, *if it be possible for God to make a free agent, then man is free, though I see not the way of it.*"

[1] In speaking disrespectfully of the personal character of Hobbes, I allude to the base servility of his political principles, and to the suppleness with which he adapted them to the opposite interests of the three successive governments under which his literary life was spent. To his private virtues the most honourable testimony has been borne, both by his friends and by his enemies.

many proselytes; the extravagant and alarming consequences in which his system terminated, serving with most persons as a sufficient antidote against it. Clarke was probably the first who perceived distinctly the logical accuracy of his reasoning; and that, if the principles were admitted, it was impossible to resist the conclusions deduced from them.[1] It seems to have been the object both of Leibnitz and of Collins, to obviate the force of this indirect argument against the scheme of necessity, by attempting to reconcile it with the moral agency of man; a task which, I think, it must be allowed, was much less ably and plausibly executed by the former than by the latter. Convinced, on the other hand, that Spinoza had reasoned from his premises much more rigorously than either Collins or Leibnitz, Clarke bent the whole force of his mind to demonstrate that these premises were false; and, at the same time, to put incautious reasoners on their guard against the seducing sophistry of his antagonists, by showing, that there was no medium between admitting the free-agency of man, and of acquiescing in all the monstrous absurdities which the creed of Spinoza involves.

Spinoza,[2] it may be proper to mention, was an Amsterdam Jew of Portuguese extraction, who (with a view probably to gain a more favourable reception to his philosophical dogmas) withdrew himself from the sect in which he had been educated, and afterwards appears to have lived chiefly in the society of Christians;[3] without, however, making any public profession of the Christian faith, or even submitting to the ceremony of baptism. In his philosophical creed, he at first embraced the system of Descartes, and began his literary career with

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[1] Dr Reid's opinion on this point coincides exactly with that of Clarke. See his Essays on the *Active Powers of Man* (p. 289, 4to Edition), where he pronounces the system of Spinoza to be "the genuine, and the most tenable system of necessity."

[2] Born 1632, died 1677. It is observed by Bayle, that "although Spinoza was the first who reduced Atheism to a system, and formed it into a body of doctrine, connected according to the method of geometricians, yet, in other respects, his opinion is not new, the substance of it being the same with that of several other philosophers, both ancient and modern, European and Eastern." See his Dict. art. *Spinoza*, and the authorities in Note (A.)

It is asserted by a late German writer, that "Spinoza has been little heard of in England, and not at all in France, and that he has been zealously defended and attacked by Germans alone." The same writer informs us, that "the philosophy of Leibnitz has been little studied in France, and not at all in England." (*Lectures on the History of Literature*, by Fred. Schlegel. English trans. published at Edin. 1818. Vol. II. p. 243.)

Is it possible that an author who pronounces so dogmatically upon the philosophy of England, should never have heard the name of Dr Clarke?

[3] The Synagogue were so indignant at his apostacy, that they pronounced against him their *highest* sentence of excommunication called *Schammata*. The form of the sentence may be found in the Treatise of Selden, *De Jure Naturæ et Gentium*, Lib. IV. c. 7. It is a document of some curiosity, and will scarcely suffer by a comparison with the Popish form of excommunication recorded by Sterne. For some farther particulars with repect to Spinoza see Note (R.)

a work entitled, ***Renati Descartes Principiorum Philosophiæ, Pars Prima et Secunda, More Geometrico Demonstratæ***, 1663. It was, however, in little else than his physical principles that he agreed with Descartes; for no two philosophers ever differed more widely in their metaphysical and theological tenets. *Fontenelle* characterizes his system as a "Cartesianism pushed to extravagance" *(une Cartesianisme outrée)*: an expression which, although far from conveying a just or adequate idea of the whole spirit of his doctrines, applies very happily to his boldness and pertinacity in following out his avowed principles to the most paradoxical consequences which he conceived them to involve. The reputation of these writings, accordingly, has fallen entirely (excepting perhaps in Germany and in Holland) with the philosophy on which they were grafted: although some of the most obnoxious opinions contained in them are still, from time to time, obtruded on the world, under the disguise of a new form, and of a phraseology less revolting to modern taste.

In no part of Spinoza's works has he avowed himself an atheist; but it will not be disputed, by those who comprehend the drift of his reasonings, that, in point of practical tendency, Atheism and Spinozism are one and the same. In this respect, we may apply to Spinoza (and[1] I may add to Vanini also) what Cicero has said of Epicurus: *Verbis reliquit Deos, re sustulit*;—a remark which coincides exactly with an expression of Newton's in the *Scholium* at the end of the *Principia*: "DEUS sine dominio, providentia, et causis finalibus, nihil aliud est quam FATUM et NATURA."

Among other doctrines of natural and revealed religion which Spinoza affected to embrace, was that of the Divine Omnipresence; a doctrine which, combined with the Plenum of Descartes, led him, by a short and plausible process of reasoning, to the revival of the old theory which represented God as *the soul of the world*; or rather to that identification of God and of the material universe, which I take to be still more agreeable to the idea of Spinoza.[2] I am particularly anxious to direct the attention of my readers to this part of

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[1] One of the most elaborate and acute refutations of Spinozism which has yet appeared is to be found in Bayle's Dictionary, where it is described as "the most monstrous scheme imaginable, and the most diametrically opposite to the clearest notions of the mind." The same author affirms, that "it has been fully overthrown even by the weakest of its adversaries."—"It does not, indeed, appear possible" (as Mr Maclaurin has observed) "to invent another system equally absurd; amounting (as it does in fact) to this proposition, that there is but one substance in the universe, endowed with infinite attributes (particularly infinite extension and cogitation), which produces all other things necessarily as its own modifications, and which alone is, in all events, both physical and moral, at once cause and effect, agent and patient."—*View of Newton's Discoveries*, Book I. Chap. 4.

[2] Spinoza supposes that there are in God two eternal properties, thought and extension; and as he held, with Descartes, that extension is the essence of matter, he must necessarily have conceived *materiality* to be

his system, as I conceive it to be at present very generally misrepresented, or, at least, very generally misunderstood; a thing not to be wondered at, considering the total neglect

an essential attribute of God. "Per Corpus intelligo modum, qui Dei essentiam quatenus ut res extensa consideratur, certo et determinato modo exprimit." (*Ethica ordine Geometrico Demonstrata.* Pars 2. Defin. 1. See also *Ethic.* Pars 1. Prop. 14.) With respect to the other attributes of God, he held, that God is the *cause* of all things; but that he acts, not from choice, but from necessity; and, of consequence, that he is the involuntary author of all the good and evil, virtue and vice, which are exhibited in human life. "Res nullo alio modo, neque alio ordine a Deo produci potuerunt, quam productæ sunt." (*Ibid.* Pars 1. Prop. 33.) In one of his letters to Mr Oldenburgh (Letter 21), he acknowledges, that his ideas of God and of nature were very different from those entertained by *modern* Christians; adding by way of explanation, "Deum rerum omnium causam immanentem, non vero transeuntem statuo;"—an expression to which I can annex no other meaning but this, that God is inseparably and essentially united with his works, and that they form together but one being.

The diversity of opinions entertained concerning the nature of Spinozism has been chiefly owing to this, that some have formed their notions of it from the books which Spinoza published during his life, and others from his posthumous remains. It is in the last alone (particularly in his *Ethics*) that his system is to be seen completely unveiled and undisguised. In the former, and also in the letters addressed to his friends, he occasionally accommodates himself, with a very temporizing spirit, to what he considered as the prejudices of the world. In proof of this, see his *Tractatus Theologico-Politicus,* and his epistolary correspondence, *passim*; above all, his letter to a young friend who had apostatized from Protestantism to the Catholic Church. The letter is addressed, Nobilissimo Juveni, *Alberto Burgh.* (*Spin. Op.* T. II. p. 695.)

The edition of Spinoza's works, to which my references are made, is the complete and very accurate one published at Jena in 1802, by Henr. Eberh. Gottlob Paulus, who styles himself Doctor and Professor of Theology.

This learned divine is at no pains to conceal his admiration of the character as well as talents of his author; nor does he seem to have much to object to the system of Spinozism, as explained in his posthumous work upon Ethics; a work which, the editor admits, contains the only genuine exposition of Spinoza's creed. "Sedes systematis quod sibi condidit in ethica est." (*Præf. Iteratæ Editionis,* p. ix.) In what manner all this was reconciled in his theological lectures with the doctrines either of natural or of revealed religion, it is not very easy to imagine. Perhaps he only affords a new example of what Dr Clarke long ago remarked, that "Believing too much and too little have commonly the luck to meet together, like two things moving contrary ways in the same circle." (*Third Letter to Dodwell.*)

A late German writer, who, in his own opinions, has certainly no leaning towards Spinozism, has yet spoken of the moral tendency of Spinoza's writings, in terms of the warmest praise. "The morality of Spinoza (says M. Fred. Schlegel) is not indeed that of the Bible, for he himself was no Christian, but it is still a pure and noble morality, resembling that of the ancient Stoics, perhaps possessing considerable advantages over that system. That which makes him strong when opposed to adversaries, who do not understand or feel his depth, or who unconsciously have fallen into errors not much different from his, is not merely the scientific clearness and decision of his intellect, but in a much higher degree the openheartedness, strong feeling, and conviction, with which all that he says seems to gush from his heart and soul." (*Lect. of Fred. Schlegel,* Eng. Trans. Vol. II. p. 244.) The rest of the passage, which contains a sort of apology for the system of Spinoza, is still more curious.

Although it is with the metaphysical tenets of Spinoza alone that we are immediately concerned at pre-

into which his works have long fallen. It is only in this way I can account for the frequent use which has most unfairly been made of the term *Spinozism* to stigmatise and discredit some doctrines, or rather some modes of speaking, which have been sanctioned, not only by the wisest of the ancients, but by the highest names in English philosophy and literature; and which, whether right or wrong, will be found, on a careful examination and comparison, not to have the most distant affinity to the absurd creed with which they have been confounded. I am afraid that Pope, in the following lines of the *Dunciad*, suffered himself so far to be misled by the malignity of Warburton, as to aim a secret stab at Newton and Clarke, by associating their figurative, and not altogether unexceptionable language,

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sent, it is not altogether foreign to my purpose to observe, that he had also speculated much about the principles of government; and that the coincidence of his opinions with those of Hobbes, on this last subject, was not less remarkable than the similarity of their views on the most important questions of metaphysics and ethics. Unconnected as these different branches of knowledge may at first appear, the theories of Spinoza and of Hobbes concerning *all* of them, formed parts of one and the same system; the whole terminating ultimately in the maxim with which (according to Plutarch) Anaxarchus consoled Alexander after the murder of Clytus: Παν το πραχθεν απο του κρατουντος δικαιον ειναι. Even in discussing the question about Liberty and Necessity, Hobbes cannot help glancing at this political corollary. "The *power* of God alone is a sufficient *justification* of any action he doth." .... "That which he doth is made just by his doing it." ..... "Power irresistible justifies *all* actions really and properly, in whomsoever it be found." (*Of Liberty and Necessity*, addressed to the Lord Marquis of Newcastle.) Spinoza has expressed himself exactly to the same purpose. (See his *Tractatus Politicus*, Cap. 2. §§ 3, 4.) So steadily, indeed, is this practical application of their abstract principles kept in view by both these writers, that not one generous feeling is ever suffered to escape the pen of either in favour of the rights, the liberties, or the improvement of their species.

The close affinity between those abstract theories which tend to degrade human nature, and that accommodating morality which prepares the minds of men for receiving passively the yoke of slavery, although too little attended to by the writers of literary history, has not been overlooked by those deeper politicians who are disposed (as has been alleged of the first of the Cæsars) to have considered their fellow-creatures "but as rubbish in the way of their ambition, or tools to be employed in removing it." This practical tendency of the Epicurean philosophy is remarked by one of the wisest of the Roman statesmen; and we learn from the same high authority, how fashionable this philosophy was in the higher circles of his countrymen, at that disastrous period which immediately preceded the ruin of the Republic. "Nunquam audivi in Epicuri schola, Lycurgum, Solonem, Miltiadem, Themistoclem, Epaminondam nominari; qui in ore sunt ceterorum omnium philosophorum." (*De Fin.* Lib. ii. c. 21.) "Nec tamen Epicuri licet oblivisci, si cupiam; cujus imaginem non modo in tabulis nostri familiares, sed etiam in poculis, et annulis habent." (*Ibid.* Lib. v c. 1.)

The prevalence of Hobbism at the court of Charles II. (a fact acknowledged by Clarendon himself) is but one of the many instances which might be quoted from modern times in confirmation of these remarks.

The practical tendency of such doctrines as would pave the way to universal scepticism, by holding up to ridicule the extravagancies and inconsistencies of the learned, is precisely similar. We are told by Tacitus (*Annal.* Lib. 14), that Nero was accustomed, at the close of a banquet, to summon a party of philosophers, that he might amuse himself with listening to the endless diversity and discordancy of their respective systems; nor were there wanting philosophers at Rome, the same historian adds, who were flattered to be thus exhibited as a

concerning *space* (when they called it the *sensorium* of the Deity), with the opinion of Spinoza, as I have just explained it.[1]

> "Thrust some Mechanic Cause into His place,
> Or bind in matter, or *diffuse in space*."

How little was it suspected by the poet, when this sarcasm escaped him, that the charge of Spinozism and Pantheism was afterwards to be brought against himself for the sublimest passage to be found in his writings!

> "All are but parts of one stupendous whole,
> Whose body Nature is, and God the soul
> \- - - - -
> Lives through all Life, *extends through all extent*,
> *Spreads undivided*, operates unspent."[2]

Bayle was, I think, the writer who first led the way to this misapplication of the term *Spinozism*; and his object in doing so, was plainly to destroy the effect of the most refined and philosophical conceptions of the Deity which were ever formed by the unassisted power of human reason.

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spectacle at the table of the Emperor. What a deep and instructive moral is conveyed by this anecdote! and what a contrast does it afford to the sentiment of one of Nero's successors, who was himself a philosopher in the best sense of the word, and whose reign furnishes some of the fairest pages in the annals of the human race! "I search for truth (says Marcus Antoninus), by which no person has ever been injured." Ζητῶ γὰρ τὴν ἀλήθειαν, ὑφ' ἧς οὐδεὶς πώποτε ἐβλάβη.

[1] Warburton, indeed, always *professes* great respect for Newton, but of his hostility to Clarke it is unnecessary to produce any other proof than his note on the following line of the Dunciad

> "Where Tindal dictates, and Silenus snores."
> B. iv. l 492.

May I venture to add, that the noted line of the *Essay on Man*,

> "And showed a Newton as we show an ape,"

could not possibly have been written by any person impressed with a due veneration for this glory of his species?

[2] This passage (as Warburton has remarked) bears a very striking analogy to a noble one in the old Orphic verses quoted in the treatise Περὶ κόσμου, ascribed to Aristotle, and it is not a little curious, that the same ideas occur in some specimens of *Hindoo* poetry, translated by Sir W. Jones, more particularly in the Hymn to *Narrayna*, or the Spirit of God, taken, as he informs us, from the writings of their ancient authors;

> Omniscient Spirit, whose all-ruling power
> Bids from each sense bright emanations beam;
> Glows in the rainbow sparkles in the stream,
> &c. &c.

"Estne Dei sedes nisi terra, et pontus, et aer,
Et cœlum, et virtus? Superos quid quærimus ultra?
Jupiter est quodcumque vides, quocumque moveris.'

"Is there a place that God would choose to love
Beyond this earth, the seas, yon Heaven above
And virtuous minds, the noblest throne for Jove?
Why seek we farther then? Behold around,
How all thou seest does with the God abound,
Jove is alike to all, and always to be found."

ROWE's *Lucan*.

Who, but Bayle, could have thought of extracting anything like Spinozism from such verses as these!

On a subject so infinitely disproportioned to our faculties, it is vain to expect language which will bear a logical and captious examination. Even the Sacred Writers themselves are forced to adapt their phraseology to the comprehension of those to whom it is addressed, and frequently borrow the figurative diction of poetry to convey ideas which must be interpreted, not according to the letter, but the spirit of the passage. It is thus that thunder is called the voice of God; the wind, His breath; and the tempest, the blast of His nostrils. Not attending to this circumstance, or rather not choosing to direct to it the attention of his readers, Spinoza has laid hold of the well known expression of St Paul, that "in God we live, and move, and have our being," as a proof that the ideas of the apostle, concerning the Divine Nature, were pretty much the same with his own; a consideration which, if duly weighed, might have protected some of the passages above quoted from the uncharitable criticisms to which they have frequently been exposed.[1]

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[1] Mr Gibbon, in commenting upon the celebrated lines of Virgil,

"Spiritus intus alit, totamque infusa per artus,
"Mens agitat molem, et magno se corpore miscet,"

observes, that "the mind which is INFUSED into the different parts of matter, and which MINGLES ITSELF with the mighty mass, scarcely retains any property of a spiritual substance, and bears too near an affinity to the principles which the impious Spinoza revived rather than invented." He adds, however, that "the poverty of human language, and the obscurity of human ideas, make it difficult to speak worthily of the GREAT FIRST CAUSE, and that our most religious poets (particularly Pope and Thomson), in striving to express the presence and energy of the Deity in every part of the universe, deviate unwarily into images which require a favourable construction. But these writers (he candidly remarks) deserve that favour, by the sublime manner in which they celebrate the Great Father of the universe, and by those effusions of love and gratitude which are inconsistent with the materialist's system." (*Misc. Works*, Vol. II. pp. 509, 510.)

May I be permitted here to remark, that it is not only *difficult* but *impossible* to speak of the omnipresence and omnipotence of God, without deviating into such images?

With the doctrine of the *Anima Mundi*, some philosophers, both ancient and modern, have connected

To return, however, to Collins, from whose controversy with Clarke I was insensibly led aside into this short digression about Spinoza: I have already said, that it seems to have been the aim of Collins to vindicate the doctrine of Necessity from the reproach brought on it by its supposed alliance with Spinozism; and to retort upon the partizans of free-will the charges of favouring atheism and immorality. In proof of this I have only to quote the account, given by the author himself, of the plan of his work:

"Too much care cannot be taken to prevent being misunderstood and prejudged, in handling questions of such nice speculation as those of Liberty and Necessity; and, therefore, though I might in justice expect to be read before any judgment be passed on me, I think it proper to premise the following observations:

"1. *First*, Though I deny *liberty* in a certain meaning of that word, yet I contend for *liberty*, as it signifies *a power in man to do as he wills or pleases.*

"2. *Secondly*, When I affirm *necessity*, I contend only for *moral necessity;* meaning thereby, that man, who is an intelligent and sensible being, is determined by his reason and his senses; and I deny man to be subject to such necessity, as is in clocks, watches, and such other beings, which, for want of sensation and intelligence, are subject to an absolute, physical, or mechanical necessity.

"3. *Thirdly*, I have undertaken to show, that the notions I advance are so far from being inconsistent with, that they are the sole foundations of morality and laws, and of rewards and punishments in society; and that the notions I explode are subversive of them."[1]

In the prosecution of his argument on this question, Collins endeavours to show, that man is a necessary agent, 1. From our experience. (By *experience* he means our own

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another theory, according to which the souls of men are portions of the Supreme Being, with whom they are reunited at death, and in whom they are finally absorbed and lost. To assist the imagination in conceiving this theory, death has been compared to the breaking of a phial of water, immersed in the ocean. It is needless to say, that this incomprehensible jargon has no *necessary* connection with the doctrine which represents God as the soul of the wold, and that it would have been loudly disclaimed, not only by Pope and Thomson, but by Epictetus, Antoninus, and all the wisest and soberest of the Stoical school. Whatever objections, therefore, may be made to this doctrine, let not its supposed *consequences* be charged upon any but those who may expressly avow them. On such a subject (as Gibbon has well remarked), "we should be slow to suspect, and still slower to condemn." (*Ibid.* p. 510.)

Sir William Jones mentions a very curious modification of this theory of *absorption*, as one of the doctrines of the *Vedanta* school. "The Vedanta school represent *Elysian* happiness as a total absorption, *though not such as to destroy consciousness*, in the Divine Essence." (*Dissertation on the Gods of Greece, Italy, and India.*)

[1] *A Philosophical Inquiry concerning Human Liberty*, 3d Edit. Lond. 1735.

consciousness that we *are* necessary agents.) 2. From the impossibility of liberty.[1] 3. From the consideration of the Divine prescience. 4. From the nature and use of rewards and punishments; and, 5. From the nature of morality.[2]

In this view of the subject, and, indeed, in the very selection of his premises, it is remarkable how completely Collins has anticipated Dr Jonathan Edwards, the most celebrated and indisputably the ablest champion of the scheme of Necessity who has since appeared. The coincidence is so perfect, that the outline given by the former, of the plan of his work, might have served with equal propriety as a preface to that of the latter.

From the above summary, and still more from the whole tenor of the *Philosophical Inquiry*, it is evident, that Collins (one of the most obnoxious writers of his day to divines of all denominations) was not less solicitious than his successor Edwards to reconcile his metaphysical notions with man's accountableness and moral agency. The remarks, accordingly, of Clarke upon Collins's work, are equally applicable to that of Edwards. It is to be regretted that they seem never to have fallen into the hands of this very acute and honest reasoner. As for Collins, it is a remarkable circumstance, that he attempted no reply to this tract of Clarke's, although he lived twelve years after its publication. The reasonings contained in it, together with those on the same subject in his correspondence with Leibnitz, and in his *Demonstration of the Being and Attributes of God*, form, in my humble opinion, the most important as well as powerful of all his metaphysical arguments.[3] The adversaries with whom he had to contend were, both of them, eminently distinguished by ingenuity and subtlety, and he seems to have put forth to the utmost his logical strength, in contending with such antagonists. "The liberty or moral agency of man (says his friend Bishop Hoadly) was a darling point to him. He excelled always, and showed a superiority to all, whenever it came into private discourse or public debate. But he never more excelled than when he was pressed with the strength Leibnitz was master of; which made him exert all his talents to set it once again in a clear light, to guard it against the evil of metaphysical obscurities, and to give the finishing stroke to a subject which must ever be the foundation of morality in man, and is the ground of the accountableness of intelligent creatures for all their actions."[4]

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[1] See Note (S.)

[2] See Note (T.)

[3] Voltaire, who, in all probability, never read either Clarke or Collins, has said that the former replied to the latter only by *Theological* reasonings: "*Clarke n'a repondu à Collins qu'en Theologien.*" (*Quest. sur l'Encyclopedie*, Art. *Liberté.*) Nothing can be more remote from the truth. The argument of Clarke is wholly *Metaphysical*; whereas, his antagonist, in various instances, has attempted to wrest to his own purposes the words of Scripture.

[4] Preface to the Folio Ed. of Clarke's *Works*.—The vital importance which Clarke attached to this ques-

It is needless to say, that neither Leibnitz nor Collins admitted the fairness of the inferences which Clarke conceived to follow from the scheme of necessity: But almost every page in the subsequent history of this controversey may be regarded as an additional illustration of the soundness of Clarke's reasonings, and of the sagacity with which he anticipated the fatal errors likely to issue from the system which he opposed.

"Thus (says a very learned disciple of Leibnitz, who made his first appearance as an author about thirty years after the death of his master)[1]—Thus, the same chain embraces the physical and moral worlds, binds the past to the present, the present to the future, the future to eternity.

"That wisdom which has ordained the existence of this chain, has doubtless willed that of every link of which it is composed. A CALIGULA is one of those links, and this link is of iron: A MARCUS AURELIUS is another link, and this link is of gold. *Both* are necessary parts of one whole, which could not but exist. Shall God then be angry at the sight of the iron link? What absurdity! God esteems this link at its proper value: He sees it in its cause, and he approves this cause, for it is good. God beholds moral monsters as he beholds physical monsters. Happy is the link of gold! Still more happy if he know that he is *only fortunate*.[2] He has attained the highest degree of moral perfection, and is nevertheless without pride, knowing that what he is, is the necessary result of the place which he must occupy in the chain."

"The gospel is the allegorical exposition of this system; the simile of the potter is its summary."[3] (Bonnet, T. VIII. pp. 237, 238.)

In what essential respect does this system differ from that of Spinoza? Is it not even more dangerous in its practical tendency, in consequence of the high strain of mystical devotion by which it is exalted?[4]

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tion, has given to the concluding paragraphs of his remarks on Collins, an earnestness and a solemnity of which there are not many instances in his writings. These paragraphs cannot be too strongly recommended to the attention of those well-meaning persons, who, in our own times, have come forward as the apostles of Dr Priestley's "great and glorious Doctrine of Philosophical Necessity"

[1] Charles Bonnet, born 1720, died 1793.

[2] The words in the original are, "Heureux le chaînon d'or! plus *heureux* encore, s'il sait qu'il n'est qu'*heureux*" The double meaning of *heureux*, if it render the expression less logically precise, gives it at least an epigrammatic turn, which cannot be preserved in our language.

[3] See Note (U.)

[4] Among the various forms which religious enthusiasm assumes, there is a certain prostration of the mind, which, under the specious disguise of a deep humility, aims at exalting the Divine perfections, by annihilating all the powers which belong to Human Nature. "Nothing is more usual for fervent devotion (says Sir James Mackintosh, in speaking of some theories current among the Hindoos), than to dwell so

This objection, however, does not apply to the quotations which follow. They exhibit, without any colourings of imagination or of enthusiasm, the scheme of necessity pushed to the remotest and most alarming conclusions which it appeared to Clarke to involve; and as they express the serious and avowed creed of two of our contemporaries (both of them men of distinguished talents), may be regarded as a proof, that the zeal displayed by Clarke against the metaphysical principles which led ultimately to such results, was not so unfounded as some worthy and able inquirers have supposed.

May I be permitted to observe farther on this head, that, as one of these writers spent his life in the pay of a German prince, and as the other was the favourite philosopher of another sovereign, still more illustrious, the sentiments which they were so anxious to proclaim to the world, may be presumed to have been not very offensive (in their judgments) to the ears of their protectors?

"All that is must be (says the Baron de Grimm, addressing himself to the Duke of Saxe-Gotha), All that is must be, even because it is; this is the only sound philosophy; as long as we do not know this universe *a priori* (as they say in the schools), ALL IS NECESSITY.[1] Liberty is a word without meaning, as you shall see in the letter of M. Diderot."

The following passage is extracted from Diderot's letter here referred to:

"I am now, my dear friend, going to quit the tone of a preacher, to take, if I can, that of a philosopher. Examine it narrowly, and you will see that the word *Liberty* is a word devoid of meaning;[2] that there are not, and that there cannot be free beings; that we

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long and so warmly on the meanness and worthlessness of created things, and on the all-sufficiency of the Supreme Being, that it slides insensibly from comparative to absolute language, and in the eagerness of its zeal to magnify the Deity, seems to annihilate everything else." (See *Philosophy of the Human Mind*, Vol. II. p. 529, 2d Ed.)

This excellent observation may serve to account for the zeal displayed by Bonnet, and many other devout men, in favour of the scheme of Necessity. "We have nothing (they frequently and justly remind us) but what we have received."—But the question here is simply a matter of fact, whether we have or have not *received* from *God* the gift of Free-Will; and the only argument, it must be remembered, which they have yet been able to advance for the negative proposition, is, that this gift was *impossible*, even for the power of God; nay, the same argument which annihilates the power of Man, annihilates that of God also, and subjects him, as well as all his creatures, to the control of causes which he is unable to resist. So completely does this scheme defeat the pious views in which it has sometimes originated.—I say *sometimes;* for the very same argument against the liberty of the Will is employed by Spinoza, according to whom the free-agency of man involves the absurd supposition of an *imperium in imperio* in the universe. (*Tractat. Polit.* Cap. II. § 6.)

[1] The logical inference ought undoubtedly to have been, "As long as we know nothing of the universe *a priori*, we are not entitled to say of anything that it either is, or is not, necessary."

[2] Does not this remark of Diderot apply with infinitely greater force to the word *necessity*, as employed in this controversy?

are only what accords with the general order, with our organization, our education, and the chain of events. These dispose of us invincibly. We can no more conceive a being acting without a motive, than we can one of the arms of a balance acting without a weight. The motive is always exterior and foreign, fastened upon us by some cause distinct from ourselves. What deceives us, is the prodigious variety of our actions, joined to the habit which we catch at our birth, of confounding the voluntary and the free. We have been so often praised and blamed, and have so often praised and blamed others, that we contract an inveterate prejudice of believing that we and they will and act freely. But if there is no liberty, there is no action that merits either praise or blame; neither vice nor virtue, nothing that ought either to be rewarded or punished. What then is the distinction among men? The doing of good and the doing of ill! The doer of ill is one who must be destroyed, not punished. The doer of good is lucky, not virtuous. But though neither the doer of good or of ill be free, man is nevertheless a being to be modified; it is for this reason the doer of ill should be destroyed upon the scaffold. From thence the good effects of education, of pleasure, of grief, of grandeur, of poverty, &c.; from thence a philosophy full of pity, strongly attached to the good, nor more angry with the wicked, than with the whirlwind which fills one's eyes with dust. Strictly speaking, there is but *one sort of causes, that is, physical* causes. There is but one sort of necessity, which is the same for all beings. This is what reconciles me to humankind: it is for this reason I exhorted you to philanthropy. Adopt these principles if you think them good, or show me that they are bad. If you adopt them, they will reconcile *you* too with others and with yourself: you will neither be pleased nor angry with yourself for being what you are. Reproach others for nothing, and repent of nothing; this is the first step to wisdom. Besides this, all is prejudice and false philosophy."[1]

The prevalence of the principles here so earnestly inculcated among the higher orders in France, at a period somewhat later in the history of the monarchy, may be judged of from the occasional allusions to them in the dramatic pieces then chiefly in request at Paris. In the *Mariage de Figaro* (the popularity of which was quite unexampled), the hero of

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[1] Nearly to the same purpose, we are told by Mr. Belsham, that "the *fallacious* feeling of *remorse* is superseded by the doctrine of necessity." (*Elem.* p. 284.) And, again, "*Remorse* supposes free-will. It is of little or no use in moral discipline. In a degree, it is even pernicious." (*Ibid.* p. 406.)

Nor does the opinion of Hartley seem to have been different. "The doctrine of necessity has a tendency to abate all resentment against men. Since all they do against us is by the appointment of God, it is rebellion against him to be offended with them."

For the originals of the quotations from Grimm and Diderot, see Note (X.)

the piece, an intriguing valet in the service of a Spanish courtier, is introduced as thus moralizing, in a soliloquy on his own free-agency and personal identity. Such an exhibition upon the English stage would have been universally censured as out of character and extravagant, or rather, would have been completely unintelligible to the crowds by which our theatres are filled.

"Oh bisarre suite d'evènemens! Comment cela m'a-t-il arrivé? Pourquoi ces choses et non pas d'autres? Qui les a fixées sur ma tête? Forcé de parcourir la route òu je suis entré sans le savoir, comme j'en sortirai sans le vouloir, je l'ai jonchée d'autant de fleurs que ma gaieté me la permit; encore je dis *ma* gaieté, sans savoir si elle est à moi plus que le reste, ni même qui est ce *moi* dont je m'occupe."

That this soliloquy, though put into the mouth of Figaro, was meant as a picture of the philosophical jargon at that time affected by courtiers and men of the world, will not be doubted by those, who have attended to the importance of the *roles* commonly assigned to confidential valets in French comedies; and to the habits of familiarity in which they are always represented as living with their masters. The sentiments which they are made to utter may, accordingly, be safely considered as but an echo of the lessons which they have learned from their superiors.[1]

My anxiety to state, without any interruption, my remarks on some of the most important questions to which the attention of the public was called by the speculations of Locke, of Leibnitz, of Newton, and of Clarke, has led me, in various instances, to depart from the strict order of chronology. It is time for me, however, now to pause, and, before I proceed farther, to supply a few chasms in the foregoing sketch.

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[1] A reflection of Voltaire's on the writings of Spinoza may, I think, be here quoted without impropriety. "Vous êtes très confus Baruc Spinoza, mais êtes vous aussi dangereux qu'on le dit? Je soutiens que non, et ma raison c'est que vous êtes confus, que vous avez ecrit en mauvais Latin, et qu'il n'y a pas dix personnes en Europe qui vous lisent d'un bout à l'autre. Quel est l'auteur dangereux? C'est celui qui est lu par les Oisifs de la Cour, et par les Dames." (*Quest. sur l'Encyclop.* Art. *Dieu.*)

Had Voltaire kept this last remark steadily in view in his own writings, how many of those pages would he have cancelled which he has given to the world!

SECTION IV.

Of some Authors who have contributed, by their Critical or Historical Writings, to diffuse a Taste for Metaphysical Studies—Bayle—Fontenelle—Addison. Metaphysical Works of Berkeley.

AMONG the many eminent persons who were either driven from France, or who went into voluntary exile, in consequence of the revocation of the edict of Nantz, the most illustrious by far was Bayle;[1] who, fixing his residence in Holland, and availing himself, to the utmost extent, of the religious toleration then enjoyed in that country, diffused from thence, over Europe, a greater mass of accurate and curious information, accompanied by a more splendid display of acute and lively criticism, than had ever before come from the pen of a single individual.[2] Happy! if he had been able to restrain within due bounds his passion for sceptical and licentious discussion, and to respect the feelings of the wise and good, on topics connected with religion and morality. But, in the peculiar circumstances in which he was educated, combined with the seducing profession of a literary adventurer, to which his hard fortune condemned him, such a spirit of moderation was rather to be wished than expected.

When Bayle first appeared as an author, the opinions of the learned still continued to be divided between Aristotle and Descartes. A considerable number leaned, in secret, to the metaphysical creed of Spinoza and of Hobbes; while the clergy of the Roman Catholic and the Protestant churches, instead of uniting their efforts in defence of those truths which they professed in common, wasted their strength against each other in fruitless disputes and recriminations.

In the midst of these controversies, Bayle, keeping aloof as far as possible from all the parties, indulged his sceptical and ironical humour at the common expence of the various combatants. Unattached himself to any system, or, to speak more correctly, unfixed in his opinions on the most fundamental questions, he did not prosecute any particular study

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[1] Born in 1647, died 1705.

[2] The erudition of Bayle is greatly undervalued by his antagonist Le Clerc. "Toutes les lumières philosophiques de M. Bayle consistoient en quelque peu de Péripatétisme, qu'il avoit appris des Jésuites de Toulouse, et un peu de Cartésianisme, qu'il n'avoit jamais approfondi." (*Bib. Choisie*, Tom. XII p. 106.)

In the judgment of Gibbon, "Bayle's learning was chiefly confined to the Latin authors, and he had more of a certain multifarious reading than of real erudition. Le Clerk, his great antagonist, was as superior to him in that respect as inferior in every other." (*Extraits Raisonnés de mes Lectures*, p. 62.)

with sufficient perseverence to add materially to the stock of useful knowledge. The influence, however, of his writings on the taste and views of speculative men of all persuasions, has been so great, as to mark him out as one of the most conspicuous characters of his age; and I shall accordingly devote to him a larger space than may, at first sight, appear due to an author who has distinguished himself only by the extent of his historical researches, and by the sagacity and subtilty of his critical disquisitions.

We are informed by Bayle himself, that his favourite authors, during his youth, were Plutarch and Montaigne; and from *them*, it has been alleged by some of his biographers, he imbibed his first lessons of scepticism. In what manner the first of these writers should have contributed to inspire him with this temper of mind, is not very obvious. There is certainly no heathen philosopher or historian, whose morality is more pure or elevated; and none who has drawn the line between superstition and religion with a nicer hand.[1] Pope has with perfect truth said of him, that "he abounds more in strokes of good nature than any other author;" to which it may be added, that he abounds also in touches of simple and exquisite *pathos*, seldom to be met with among the greatest painters of antiquity. In all these respects what a contrast does Bayle present to Plutarch!

Considering the share which Bayle ascribes to Montaigne's Essays in forming his literary taste, it is curious, that there is no separate article allotted to Montaigne in the *Historical and Critical Dictionary*. What is still more curious, there is more than one reference to this article, as if it actually existed; without any explanation of the omission (as far as I recollect) from the author or the publisher of the work. Some very interesting particulars, however, concerning Montaigne's life and writings, are scattered over the Dictionary, in the notices of other persons, with whom his name appeared to Bayle to have a sufficient connection to furnish an apology for a short episode.

It does not seem to me a very improbable conjecture, that Bayle had intended, and perhaps attempted, to write an account of Montaigne; and that he had experienced greater

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[1] See, in particular, his account of the effects produced on the character of Pericles, by the sublime lessons of Anaxagoras.

Plutarch, it is true, had said before Bayle, that atheism is less pernicious than superstition; but how wide the difference between this paradox, as explained and qualified by the Greek philosopher, and as interpreted and applied in the *Reflections on the Comet!* Mr Addison himself seems to give his sanction to Plutarch's maxim in one of his papers on Cheerfulness. "An eminent Pagan writer has made a discourse to show, that the atheist who denies a God, does him less dishonour than the man who owns his being, but, at the same time, believes him to be cruel, hard to please, and terrible to human nature. For my own part, says he, I would rather it should be said of me, that there was never any such man as Plutarch, than that Plutarch was ill-natured, capricious, and inhuman." (*Spectator*, No. 494.)

difficulties than he was aware of, in the execution of his design. Notwithstanding their common tendency to Scepticism, no two characters were ever more strongly discriminated in their most prominent features; the doubts of the one resulting from the singular coldness of his moral temperament, combined with a subtlety and over-refinement in his habits of thinking, which rendered his ingenuity, acuteness, and erudition, more than a match for his good sense and sagacity;—the indecision of the other partaking more of the shrewd and soldier-like *étourderie* of Henry IV. when he exclaimed, after hearing two lawyers plead on opposite sides of the same question, "*Ventre St Gris! il me semble que tous les deux ont raison.*"

Independently of Bayle's constitutional bias towards Scepticism, some other motives, it is probable, conspired to induce him, in the composition of his *Dictionary*, to copy the spirit and tone of the old academic school. On these collateral motives a strong and not very favourable light is thrown by his own candid avowal in one of his letters. "In truth (says he to his correspondent Minutoli), it ought not to be thought strange, that so many persons should have inclined to Pyrrhonism; for of all things in the world it is the most convenient. You may dispute with impunity against every body you meet, without any dread of that vexatious argument which is addressed *ad hominem*. You are never afraid of a retort; for as you announce no opinion of your own, you are always ready to abandon those of others to the attacks of sophists of every description. In a word, you may dispute and jest on all subjects, without incurring any danger from the *lex talionis*."[1] It is amusing to think that the Pyrrhonism which Bayle himself has here so ingenuously accounted for, from motives of conveniency and of literary cowardice, should have been mistaken by so many of his disciples for the sportive triumph of a superior intellect over the weaknesses and errors of human reason.[2]

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[1] "En verité, il ne faut pas trouver étrange que tant des gens aient donné dans le Pyrrhonisme. Car c'est la chose du monde le plus commode. Vous pouvez impunément disputer contre tous venans, et sans craindre ces argumens *ad hominem*, qui font quelquefois tant de peine. Vous ne craignez point la rétorsion; puisque ne soutenant rien, vous abandonnez de bon cœur à tous les sophismes et à tous les raisonnemens de la terre quelque opinion que ce soit. Vous n'êtes jamais obligé d'en venir à la défensive. En un mot vous contestez et vous daubez sur toutes choses tout votre saoul, sans craindre la peine du talion." (*Oeuv. Div. de Bayle*, IV. p. 537.)

[2] The estimate formed by Warburton of Bayle's character, both intellectual and moral, is candid and temperate. "A writer whose strength and clearness of reasoning can only be equalled by the gaiety, easiness, and delicacy, of his wit; who, pervading human nature with a glance, struck into the province of paradox, as an exercise for the restless vigour of his mind: who, with a soul superior to the sharpest attacks of fortune, and a heart practised to the best philosophy, had not yet enough of real greatness, to overcome that last foible of superior geniuses, the temptation of honour, which the academical exercise of wit is supposed to bring to its professors." (*Divine Legation.*)

If there be anything objectionable in this panegyric, it is the unqualified praise bestowed on Bayle's *wit*,

The profession of Bayle, which made it an object to him to turn to account even the sweepings of his study, affords an additional explanation of the indigested mass of heterogeneous and inconsistent materials contained in his Dictionary. Had he adopted any one system exclusively, his work would have shrunk in its dimensions into a comparatively narrow compass.[1]

When these different considerations are maturely weighed, the omission by Bayle of the article *Montaigne* will not be much regretted by the admirers of the Essays. It is extremely doubtful if Bayle would have been able to seize the true spirit of Montaigne's character; and, at any rate, it is not in the delineation of character that Bayle excels. His critical acumen, indeed, in the examination of opinions and arguments, is unrivalled; but his portraits of persons commonly exhibit only the coarser lineaments which obtrude themselves on the senses of ordinary observers; and seldom, if ever, evince that discriminating and divining eye, or that sympathetic penetration into the retirements of the heart, which lend to every touch of a master artist, the never to be mistaken expression of truth and nature.

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which, though it seldom fails in copiousness, in poignancy, or in that grave argumentative irony, by which it is still more characteristically marked, is commonly as deficient in *gaiety* and *delicacy* as that of Warburton himself.

Leibnitz seems perfectly to have entered into the peculiar temper of his adversary Bayle, when he said of him, that "the only way to make Bayle write usefully, would be to attack him when he advances propositions that are sound and true; and to abstain from attacking him, when he says anything false or pernicious."

"Le vrai moyen de fairê écrire utilement M. Bayle, ce seroit de l'attaquer, lorsquil écrit des bonnes choses et vraies, car ce seroit le moyen de le piquer pour continuer. Au lieu qu'il ne faudroit point l'attaquer quand il en dit de mauvaises, car cela l'engagera à en dire d'autres aussi mauvaises pour soutenir les premières." (Tom. VI. p. 273.)

Leibnitz elsewhere says of him: *Ubi bene, nemo melius.* (Tom. I. p. 257.)

[1] "The inequality of Bayle's voluminous works (says Gibbon) is explained by his alternately writing for himself, for the bookseller, and for posterity; and if a severe critic would reduce him to a single folio, that relic, like the books of the sybils, would become still more valuable." (Gibbon's *Mem.* p. 50.)

Mr Gibbon observes in another place, that, "if Bayle wrote his *Dictionary* to empty the various collections he had made, without any particular design, he could not have chosen a better plan. It permitted him everything, and obliged him to nothing. By the double freedom of a *Dictionary* and of Notes, he could pitch on what articles he pleased, and say what he pleased on those articles. (*Extraits Raisonnés de mes Lectures,* p. 64.)

"How could such a genius as Bayle," says the same author, "employ three or four pages, and a great apparatus of learning, to examine whether Achilles was fed with marrow only; whether it was the marrow of lions and stags, or that of lions only," &c.? (*Ibid.* p. 66.)

For a long and interesting passage with respect to Bayle's history and character, see Gibbon's *Memoirs,* &c. Vol. I. pp. 49, 50, 51.

It furnishes some apology for the unsettled state of Bayle's opinions, that his habits of thinking were formed prior to the discoveries of the Newtonian School. Neither the vortices of Descartes, nor the monads and pre-established harmony of Leibnitz, were well calculated to inspire him with confidence in the powers of the human understanding; nor does he seem to have been led, either by taste or by genius, to the study of those exacter sciences in which Kepler, Galileo, and others, had, in the preceding age, made such splendid advances. In Geometry, he never proceeded beyond a few of the elementary propositions; and it is even said (although I apprehend with little probability) that his farther progress was stopped by some defect in his intellectual powers, which disqualified him for the successful prosecution of the study.

It is not unworthy of notice, that Bayle was, the son of a Calvinist minister, and was destined by his father for his own profession; that during the course of his education in a college of Jesuits, he was converted to the Roman Catholic persuasion:[1] and that finally he went to Geneva, where, if he was not recalled to the Protestant faith, he was at least most thoroughly reclaimed from the errors of popery.[2]

To these early fluctuations in his religious creed, may be ascribed his singularly accurate knowledge of controversial theology, and of the lives and tenets of the most distinguished divines of both churches,—a knowledge much more minute than a person of his talents could well be supposed to accumulate from the mere impulse of literary curiosity. In these respects he exhibits a striking resemblance to the historian of the *Decline and Fall of*

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[1] For the benefit of education, the Protestants were tempted to risk their children in the Catholic Universities; and in the 22d year of his age young Bayle was seduced by the arts and arguments of the Jesuits of Thoulouse. He remained about seventeen months in their hands a voluntary captive." (Gibson's *Misc. Works*, Vol. I. p. 49.)

[2] According to Gibbon, "the piety of Bayle was offended by the excessive worship of creatures; and *the study of physics* convinced him of the impossibility of transubstantiation, which is abundantly refuted by the testimony of our senses." (*Ibid.* p. 49.)

The same author, speaking of his own conversion from popery, observes (after allowing to his preceptor Mr Pavillard "a handsome share" of the honour), "that it was principally effected by his private reflections;" adding the following very curious acknowledgment: "I still remember my solitary transport at the discovery of a *philosophical argument* against the doctrine of *Transubstantiation*; that the text of Scripture, which seems to inculcate the real presence, is attested only by a single sense—our sight; while the real presence itself is disproved by three of our senses—the sight, the touch, and the taste." (*Ibid.* p. 58.) That this "*philosophical* argument" should have had any influence on the mind of Gibbon, even at the early period of life when he made "the discovery," would appear highly improbable, if the fact were not attested by himself; but as for Bayle, whose logical acumen was of a far harder and keener edge, it seems quite impossible to conceive, "that the study of physics" was at all necessary to open his eyes to the absurdity of the *real presence*; or that he would not at once have perceived the futility of appealing to our senses or to our reason, against an article of faith which professedly disclaims the authority of both.

the Roman Empire: Nor is the parallel between them less exact in the similar effects produced on their minds, by the polemical cast of their juvenile studies. Their common propensity to indulge in indecency is not so easily explicable. In neither does it seem to have originated in the habits of a dissolute youth; but in the wantonness of a polluted and distempered imagination. Bayle, it is well known, led the life of an anchoret;[1] and the licentiousness of his pen is, on that very account, the more reprehensible. But (everything considered) the grossness of Gibbon is certainly the more unaccountable, and perhaps the more unpardonable of the two.[2]

On the mischievous tendency of Bayle's work to unsettle the principles of superficial readers, and (what is worse) to damp the moral enthusiasm of youth, by shaking their faith in the reality of virtue, it would be superfluous to enlarge. The fact is indisputable, and is admitted even by his most partial admirers. It may not be equally useless to remark the benefits which (whether foreseen or not by the author, is of little consequence) have actually resulted to literature from his indefatigable labours. *One* thing will, I apprehend, be very generally granted in his favour, that, if he has taught men to suspend their judgment, he has taught them also to think and to reason for themselves; a lesson which appeared to a late philosophical divine of so great importance, as to suggest to him a doubt, whether it would not be better for authors to state nothing but *premises*, and to leave to their readers the task of forming their own *conclusions*.[3] Nor can Bayle be candidly accused of often discovering a partiality for any particular sect of philosophers. He opposes Spinoza and Hobbes with the same spirit and ability, and apparently with the same good faith, with which he controverts the doctrines of Anaxagoras and of Plato. Even the ancient sceptics, for whose mode of philosophizing he might be supposed to have felt some degree of tenderness, are treated with as little ceremony as the most extravagant of the dogmatists. He has been often accused of a leaning to the most absurd of all systems,

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1 "Chaste dans ses mœurs, grave dans ses discours, sobre dans ses alimens, austère dans son genre de vie." (Portrait de Bayle par M. Saurin, dans son Sermon sur l'accord de la religion avec la politique.)

2 In justice to Bayle, and also to Gibbon, it should be remembered, that over the most offensive passages in their works they have drawn the veil of the learned languages. It was reserved for the translators of the *Historical and Critical Dictionary* to tear this veil asunder, and to expose the indelicacy of their author to every curious eye. It is impossible to observe the patient industry and fidelity with which they have executed this part of their task without feelings of indignation and disgust. For such an outrage on taste and decorum, their tedious and feeble attacks on the Manicheism of Bayle offer but a poor compensation. Of all Bayle's suspected heresies, it was perhaps that which stood the least in need of a serious refutation; and, if the case had been otherwise, their incompetency to contend with such an adversary would have only injured the cause which they professed to defend.

3 See the preface to Bishop Butler's Sermons.

that of the Manicheans; and it must be owned, that there is none in defence of which he has so often and so ably[1] exerted his talents; but it is easy to perceive, that, when he does so, it is not from any serious faith which he attaches to it (perhaps the contrary supposition would be nearer the truth), but from the peculiarly ample field which it opened for the display of his controversial subtlety, and of his inexhaustible stores of miscellaneous information.[2] In one passage he has pronounced with a tone of decision which he seldom assumes, that "it is absurd, indefensible, and inconsistent with the regularity and order of the universe; that the arguments in favour of it are liable to be retorted; and that, granting it to be true, it would afford no solution of the difficulties in question."[3] The apparent zeal with which, on various occasions, he has taken up its defence, may, I think, be reasonably accounted for, by the favourable opportunity it afforded him of measuring his logical powers with those of Leibnitz.[4]

To these considerations it may be added, that, in consequence of the progress of the sciences since Bayle's time, the unlimited scepticism commonly, and perhaps justly imputed to him, is much less likely to mislead than it was a century ago; while the value of his researches, and of his critical reflections, becomes every day more conspicuous, in proportion as more enlarged views of nature, and of human affairs, enable us to combine together that mass of

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[1] Particularly in the article entitled *Paulicians.*

[2] One of the earliest as well as the ablest of those who undertook a reply to the passages in Bayle which *seem* to favour Manicheism, candidly acquits him of any serious design to recommend that system to his readers. "En répondant aux objections Manichéenes, je ne prétends faire aucum tort à M. Bayle: qui je ne soupçonne nullement de les favoriser. Je suis persuadé qu'il n'a pris la liberté philosophique de dire, en bien des rencontres, le pour et le contre, sans rien dissimuler, que pour donner de l'exercice à ceux que entendent les matières qu'il traite, et non pour favoriser ceux dont il explique les raisons." (*Parrhasiana, ou Pensées Diverses*, p. 302, par M. Le Clerc, Amsterdam, 1699.)

[3] See the illustration upon the Sceptics at the end of the Dictionary.

[4] This supposition may be thought inconsistent with the well known fact, that the Theodicée of Leibnitz was not published till after the death of Bayle. But it must be recollected, that Bayle had previously entered the lists with Leibnitz in the article *Rorarius,* where he had urged some very acute and forcible objections against the scheme of *pre-established harmony;* a scheme which leads so naturally and obviously to that of optimism, that it was not difficult to foresee what ground Leibnitz was likely to take in defending his principles. The great aim of Bayle seems to have been to provoke Leibnitz to unfold *the whole* of his system and of its necessary consequences; well knowing what advantages in the management of such a controversy would be on the side of the assailant.

The tribute paid by Leibnitz to the memory of his illustrious antagonist deserves to be quoted. "Sperandum est, *Bælium* luminibus illis nunc circumdari, quod terris negatum est: cum credibile sit, bonam voluntatem ei nequaquam defuisse."

"Candidus insuetum miratur limen Olympi,
Sub pedibusque videt nubes et sidera Daphnis."

rich but indigested materials, in the compilation of which his own opinions and principles seem to have been totally lost. Neither comprehension, indeed, nor generalization, nor metaphysical depth,[1] are to be numbered among the characteristical attributes of his genius. Far less does he ever anticipate, by the moral lights of the soul, the slow and hesitating decisions of the understanding; or touch with a privileged hand those mysterious chords to which all the social sympathies of our frame are responsive, Had his ambition, however, been more exalted, or his philanthropy more warm and diffusive, he would probably have attempted less than he actually accomplished; nor would he have stooped to enjoy that undisputed pre-eminence which the public voice has now unanimously assigned him, among those inestimable though often ill requited authors, whom Johnson has called "the pioneers of literature."

The suspense of judgment which Bayle's *Dictionary* inspires with respect to *facts*, is, perhaps, still more useful than that which it encourages in matters of abstract reasoning. Fontenelle certainly went much too far, when he said of history, that it was only a collection of *Fables Convenues*;—a most significant and happy phrase, to which I am sorry that I cannot do justice in an English version. But, though Fontenelle pushed his maxim to an extreme, there is yet a great deal of important truth in the remark; and of this I believe every person's conviction will be stronger, in proportion as his knowledge of men and of books is profound and extensive.

Of the various lessons of historical scepticism to be learned from Bayle, there is none more practically valuable (more especially in such revolutionary times as we have witnessed) than that which relates to the biographical portraits of distinguished persons, when drawn by their theological and political opponents. In illustration of this, I have only to refer to the copious and instructive extracts which he has produced from Roman Catholic writers, concerning the lives, and still more concerning the deaths, of Luther, Knox,[2] Buchanan, and various other leaders or partizans of the Reformation. It would be impossible for any well-informed Protestant to read these extracts, without indulging a smile at their incredible absurdity, if every feeling of levity were not lost in a sentiment of deep indignation at the effrontery and falsehood of their authors. In stating this observation, I have taken my examples from Roman Catholic libellers, without any illiberal prejudices against the members of that church. The injustice done by Pro-

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[1] I speak of that metaphysical *depth* which is the exclusive result of what Newton called *Patient Thinking*. In logical quickness, and metaphysical subtlety, Bayle has never been surpassed.

[2] See Note (Y.)

testants to some of the conscientious defenders of the old faith has been, in all probability, equally great; but this we have no opportunity of ascertaining here, by the same direct evidence to which we can fortunately appeal, in vindication of the three characters mentioned above. With the history of *two* of them every person in this country is fully acquainted; and I have purposely selected them in preference to others, as their *names* alone are sufficient to cover with disgrace the memory of their calumniators.[1]

A few years before the death of Bayle, Fontenelle began to attract the notice of Europe.[2] I class them together on account of the mighty influence of both on the literary taste of their contemporaries; an influence in neither case founded on any claims to original genius, or to important improvements; but on the attractions which they possessed in common (though in very different ways) as popular writers; and on the easy and agreeable access which their works opened to the opinions and speculations of the learned. Nor do I depart so far, as might at first be supposed, from the order of chronology, in passing from the one to the other. For though Fontenelle survived almost to our own times (having very nearly completed a century at the time of his death), the interval between his birth and that of Bayle was only ten years, and he had actually published several volumes, both in prose and verse, before the *Dictionary* of Bayle appeared.

But my chief reason for connecting Fontenelle rather with the contemporaries of his youth than with those of his old age is, that, during the latter part of his life, he was left far behind in his philosophical creed (for he never renounced his faith as a Cartesian[3]) by

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[1] Of all Bayle's works, "the most useful and the least sceptical," according to Gibbon, "is his *Commentaire Philosophique* on these words of the Gospel, *Compel them to come in.*"

The great object of this commentary is to establish the general principles of Toleration, and to remonstrate with the members of Protestant churches on the inconsistency of their refusing to those they esteem heretics, the same indulgence which they claim for themselves in Catholic countries. The work is diffuse and rambling, like all Bayle's compositions; but the matter is excellent, and well deserves the praise which Gibbon has bestowed on it.

[2] Bayle died in 1706. Fontenelle's first work in prose (the *Dialogues of the Dead*) was published as early as 1683, and was quickly followed by his *Conversations on the Plurality of Worlds.*

[3] Excepting on a few metaphysical points. The chief of these were, the question concerning the origin of our ideas, and that relating to the nature of the lower animals. On the former of these subject he has said explicitly: "L'Ancienne Philosophie n'a pas toujours eu tort. Elle a soutenu que tout ce qui étoit dans l'esprit avoit *passé par les sens*, et nous n'aurions pas mal fait de conserver cela d'elle." (*Fragment of an intended Treatise on the Human Mind.*) On another occasion, he states his own opinion on this point, in language coinciding exactly with that of Gassendi. "A force d'opérer sur les premières idées formées par les sens, d'y ajouter, d'en retrancher, de les rendre de particulières universelles, d'universelles plus universelles encore, l'esprit les rend si différentes de ce qu'elles étoit d'abord qu'on a quelquefois peine à reconnôitre leur origine. Cependant qui voudra

those very pupils to whose minds he had given so powerful an impulse, and whom he had so long taught by his example, the art (till then unknown in modern times) of blending the truths of the severer sciences with the lights and graces of eloquence. Even this *eloquence*, once so much admired, had ceased, before his death, to be regarded as a model, and was fast giving way to the purer and more manly taste in writing, recommended by the precepts, and exemplified in the historical compositions of Voltaire.

Fontenelle was a nephew of the great Corneille; but his genius was, in many respects, very strongly contrasted with that of the author of the *Cid*. Of this he has himself enabled us to judge by the feeble and unsuccessful attempts in dramatic poetry, by which he was first known to the world. In these, indeed, as in all his productions, there is an abundance of ingenuity, of elegance, and of courtly refinement; but not the faintest vestige of the *mens divinior*, or that of sympathy with the higher and nobler passions which enabled Corneille to reanimate and to reproduce on the stage the heroes of ancient Rome. The circumstance, however, which more peculiarly marks and distinguishes his writings, is the *French mould* in which education and habit seem to have recast all the original features of his mind;—identifying, at the same time, so perfectly the impressions of art with the workmanship of nature, that one would think the PARISIAN, as well as the MAN, had started fresh and finished from her creative hand. Even in his *Conversations on the Plurality of Worlds*, the dry discussions with the Marchioness about the now forgotten vortices of Descartes are enlivened throughout by a never-failing spirit of light and national gallantry, which will for ever render them an amusing picture of the manners of the times, and of the character of the author. The gallantry, it must be owned, is often strained and affected; but the affectation sits so well on Fontenelle, that he would appear less easy and graceful without it.

The only other production of Fontenelle's youth which deserves to be noticed is his *History of Oracles;* a work of which the aim was, to combat the popular belief that the oracles of antiquity were uttered by evil spirits, and that all these spirits became dumb at the moment of the Christian era. To this work Fontenelle contributed little more than the agreeable and lively form in which he gave it to the world; the chief materials being derived from a dull and prolix dissertation on the same subject, by a learned Dutchman. The publication excited a keen opposition among divines, both Catholic and Protestant; and, in particular, gave occasion to a very angry, and (it is said) not contemptible criticism,

prendre le fil et le suivre exactement, retournera toujours de l'idée la plus sublime et la plus élevée, à quelque idée sensible et grossière."

from a member of the Society of Jesuits.[1] It is mentioned by La Harpe, as an illustration of the rapid change in men's opinions which took place during Fontenelle's life, that a book which, in his youth, was censured for its impiety, was regarded before his death as a proof of his respect for religion.

The most solid basis of Fontenelle's fame is his *History of the Academy of Sciences*, and his *Eloges of the Academicians*. Both of these works, but more especially the latter, possess, in an eminent degree, all the charms of his former publications, and are written in a much simpler and better taste than any of the others. The materials, besides, are of inestimable value, as succinct and authentic records of one of the most memorable periods in the history of the human mind; and are distinguished by a rare impartiality towards the illustrious dead, of all countries, and of all persuasions. The philosophical reflections, too, which the author has most skilfully interwoven with his literary details, discover a depth and justness of understanding far beyond the promise of his juvenile Essays; and afford many proofs of the soundness of his logical views,[2] as well as of his acute and fine discrimination of the varieties and shades of character, both intellectual and moral.

The chief and distinguishing merit of Fontenelle, as the historian of the Academy, is the happy facility with which he adapts the most abstruse and refined speculations to the comprehension of ordinary readers. Nor is this excellence purchased by any sacrifice of scientific precision. What he aims at is nothing more than an outline; but this outline is always executed with the firm and exact hand of a master. "When employed in com-

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[1] To this criticism, the only reply made by Fontenelle was a single sentence, which he addressed to a *Journalist* who had urged him to take up arms in his own defence. "Je laisserai mon censeur jouir en paix de son triomphe; je consens que le diable ait été prophète, puisque le Jesuite le veut, et qu'il croit cela plus orthodoxe." (D'Alembert, *Eloge de la Motte.*) We are told by D'Alembert, that the silence of Fontenelle, on this occasion, was owing to the advice of La Motte. "Fontenelle bien tenté de terrasser son adversaire par la facilité qu'il y trouvoit, fut retenu par les avis prudens de la Motte; cet ami lui fit craindre de s'aliéner par sa réponse une société qui s'appeloit *Légion*, quand on avoit affaire au dernier de ses membres." The advice merits the attention of philosophers in all countries, for the spirit of Jesuitism is not confined to the Church of Rome.

[2] An instance of this which happens at present to recur to my memory, may serve to illustrate and to confirm the above remark. It is unnecessary to point out its coincidence with the views which gave birth to the new nomenclature in chemistry.

"If languages had been the work of philosophers, they might certainly be more easily learned. Philosophers would have established everywhere a systematical uniformity, which would have proved a safe and infallible guide; and the manner of forming a derivative word, would, as a necessary consequence, have suggested its signification. The uncivilized nations, who are the first authors of languages, fell naturally into that notion with respect to certain *terminations*, all of which have some common property or virtue; but that advantage, unknown to those who had it in their hands, was not carried to a sufficient extent."

position (he has somewhere said) my first concern is to be certain that I myself understand what I am about to write;" and on the utility of this practice every page of his Historical Memoirs may serve as a comment.[1]

As a writer of *Eloges*, he has not been equalled (if I may be allowed to hazard my own opinion) by any of his countrymen. Some of those, indeed, by D'Alembert and by Condorcet, manifest powers of a far higher order than belonged to Fontenelle; but neither of these writers possessed Fontenelle's incommunicable art of interesting the curiosity and the feelings of his readers in the fortunes of every individual whom he honoured by his notice. In this art it is not improbable that they might have succeeded better had they imitated Fontenelle's self-denial in sacrificing the fleeting praise of brilliant colouring, to the fidelity and lasting effect of their portraits; a self-denial which in *him* was the more meritorious, as his great ambition plainly was to unite the reputation of a *bel-esprit* with that of a philosopher. A justly celebrated academician of the present times (M. Cuvier), who has evidently adopted Fontenelle as his model, has accordingly given an interest and truth to his *Eloges* which the public had long ceased to expect in that species of composition.[2]

But the principal charm of Fontenelle's *Eloges* arises from the pleasing pictures which they everywhere present of genius and learning in the scenes of domestic life. In this respect, it has been justly said of them by M. Suard,[3] that "they form the noblest monument ever raised to the glory of the sciences and of letters." Fontenelle himself, in his

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[1] From this praise, however, must be excepted, the mysterious jargon in which (after the example of some of his contemporaries) he has indulged himself in speaking of the geometry and calculus of infinites. "Nous le disons avec peine (says D'Alembert), et sans vouloir, outrager les manes d'un homme célèbre qui n'est plus, il n'y a peut-être point d'ouvrage où l'on trouve des preuves plus fréquentes de l'abus de la métaphysique, que dans l'ouvrage très connu de M. Fontenelle, qui a pour titre *Elémens de la Géométrie de l'infini;* ouvrage dont la lecture est d'autant plus dangereuse aux jeunes géomètres que l'auteur y présente les sophismes avec une sorte d'élégance et de grace, dont le sujet ne paroissoit pas susceptible." (*Mélanges*, &c. Tom. V. p. 264.)

[2] D'Alembert, in his ingenious parallel of Fontenelle and La Motte, has made a remark on Fontenelle's style when he aims at simplicity, of the justness of which *French* critics alone are competent judges. "L'un et l'autre ont écrit en prose avec beaucoup de clairté, d'élégance, de simplicité même; mais La Motte avec une simplicité plus naturelle, et Fontenelle avec une simplicité plus étudiée: Car la simplicité peut l'étre, et dès lors elle devient manière, et cesse d'être modèle." An idea very similar to this is happily expressed by Congreve, in his portrait of *Amoret:*

> Coquet and Coy at once her air,
> Both studied, though both seem neglected;
> *Careless she is with artful care,*
> *Affecting to seem unaffected.*

[3] *Notice sur la Vie et les Ecrits du Docteur Robertson.* (Paris, 1817.)

Eloge of Varignon, after remarking, that in *him* the simplicity of his character was only equalled by the superiority of his talents, finely adds, "I have already bestowed so often the same praise on other members of this Academy, that it may be doubted whether it is not less due to the individuals, than to the sciences which they cultivated in common." What a proud reply does this reflection afford to the Machiavellian calumniators of philosophy!

The influence of these two works of Fontenelle on the studies of the rising generation all over Europe, can be conceived by those alone who have compared them with similar productions of an earlier date. Sciences which had long been immured in colleges and cloisters, began at length to breathe the ventilated and wholesome air of social life. The union of philosophy and the fine arts, so much boasted of in the schools of ancient Greece, seemed to promise a speedy and invigorated revival. Geometry, Mechanics, Physics, Metaphysics, and Morals, became objects of pursuit in courts and in camps; the accomplishments of a scholar grew more and more into repute among the other characteristics of a gentleman: and (what was of still greater importance to the world) the learned discovered the secret of cultivating the graces of writing, as a necessary passport to truth, in a refined but dissipated age.

Nor was this change of manners confined to one of the sexes. The other sex, to whom nature has entrusted the first developement of our intellectual and moral powers, and who may, therefore, be regarded as the chief *medium* through which the progress of the mind is continued from generation to generation, shared also largely in the general improvement. Fontenelle aspired above all things to be the philosopher of the Parisian circles; and certainly contributed not a little to diffuse a taste for useful knowledge among women of all conditions in France, by bringing it into vogue among the higher classes. A reformation so great and so sudden could not possibly take place, without giving birth to much affectation, extravagance, and folly; but the whole analogy of human affairs encourages us to hope, that the inconveniencies and evils connected with it will be partial and temporary, and its beneficial results permanent and progressive.[1]

[1] Among the various other respects in which Fontenelle contributed to the intellectual improvement of his countrymen, it ought to be mentioned, that he was one of the first writers in France who diverted the attention of metaphysicians from the old topics of scholastic discussion, to a philosophical investigation of the principles of the fine arts. Various original hints upon these subjects are scattered over his works; but the most favourable specimen of his talents for this very delicate species of analysis are to be found in his *Dissertation on Pastorals*, and in his *Theory concerning the Delight we derive from Tragedy*.* His

* In the judgment of Mr. Hume, "there is not a finer piece of criticism than Fontenelle's *Dissertation on Pastorals*; in which, by a number of reflections and philosophical reasonings, he endeavours to fix the just medium between Simplicity and Refinement, which is suitable to that species of poetry."

Among the various moral defects imputed to Fontenelle, that of a complete apathy and insensibility to all concerns but his own is by far the most prominent. A letter of the Baron de Grimm, written immediately after Fontenelle's death, but not published till lately, has given a new circulation in this country to some anecdotes injurious to his memory, which had long ago fallen into oblivion or contempt in France. The authority, however, of this adventurer, who earned his subsistence by collecting and retailing, for the amusement of a German Prince, the literary scandal of Paris, is not much to be relied on in estimating a character with which he does not appear to have had any opportunity of becoming personally acquainted; more especially as, during Fontenelle's long decline, the great majority of men of letters in France were disposed to throw his merits into the shade, as an acceptable homage to the rising and more dazzling glories of Voltaire.[1] It is in the

speculations, indeed, are not always just and satisfactory; but they are seldom deficient in novelty or refinement. Their principal fault, perhaps, arises from the author's disposition to carry his refinements too far; in consequence of which, his theories become chargeable with that sort of sublimated ingenuity which the French epithet *Alambiqué* expresses more precisely and forcibly than any word in our language.

Something of the same philosophical spirit may be traced in Fenelon's *Dialogues on Eloquence*, and in his *Letter on Rhetoric and Poetry*. The former of these treatises, besides its merits as a speculative discussion, contains various practical hints, well entitled to the attention of those who aspire to eminence as public speakers; and of which the most apparently trifling claim some regard, as the results of the author's reflections upon an art which few ever practised with greater success.

Let me add, that both of these eminent men (who may be regarded as the fathers of philosophical criticism in France) were zealous partizans and admirers of the Cartesian metaphysics. It is this *critical* branch of metaphysical science which, in my opinion, has been most successfully cultivated by French writers; although too many of them have been infected (after the example of Fontenelle) with the disease of sickly and of *hyper-metaphysical* subtlety.

From this censure, however, must be excepted the Abbé Dubos, whose *Critical Reflections on Poetry and Painting* is one of the most agreeable and instructive works that can be put into the hands of youth. Few books are better calculated for leading their minds gradually from literature to philosophy. The author's theories, if not always profound or just, are in general marked with good sense as well as with ingenuity; and the subjects to which they relate are so peculiarly attractive, as to fix the attention even of those readers who have but little relish for speculative discussions. "Ce qui fait la bonté de cet ouvrage (says Voltaire) c'est qu'il n'y a que peu d'erreurs, et beaucoup de réflexions vraies, nouvelles, et profondes. Il manque cependant d'ordre et sur-tout de précision; il auroit pu être écrit avec plus de feu, de grace et d'élégance; *mais l'écrivain pense et fait penser.*" *(Siècle de Louis XIV.)*

[1] As to Voltaire himself, it must be mentioned, to his honour, that though there seems never to have been much cordiality between him and Fontenelle, he had yet the magnanimity to give a place to this Nestor of French literature in his catalogue of the eminent persons who adorned the reign of Louis XIV.; a tribute of respect the more flattering, as it is the single instance in which he has departed from his general rule of excluding from his list the names of all his living contemporaries. Even Fontenelle's most devoted admirers ought to be satisfied with the liberality of Voltaire's eulogy, in which, after pronouncing Fontenelle "the most universal genius which the age of Louis XIV. had produced," he thus sums up his merits as author: "Enfin on l'a re-

Academical Memoirs of D'Alembert and Condorcet (neither of whom can be suspected of any unjust prejudice against Voltaire, but who were both too candid to sacrifice truth to party feelings) that we ought to search for Fontenelle's real portrait:[1] Or rather (if it be true, as Dr Hutcheson has somewhere remarked, that "men have commonly the good or bad qualities which they ascribe to mankind") the most faithful *Eloge* on Fontenelle himself is to be found in those which he has pronounced upon others.

That the character of Fontenelle would have been more amiable and interesting, had his virtues been less the result of cold and prudent calculation, it is impossible to dispute. But his conduct through life was pure and blameless; and the happy serenity of his temper, which prolonged his life till he had almost completed his hundredth year, served as the best comment on the spirit of that mild and benevolent philosophy, of which he had laboured so long to extend the empire.

It is a circumstance almost singular in his history, that, since the period of his death, his reputation, both as a man and as an author, has been gradually rising. The fact has been as remarkably the reverse with most of those who have calumniated his memory.

While the circle of mental cultivation was thus rapidly widening in France, a similar progress was taking place, upon a larger scale, and under still more favourable circumstances, in England. To this progress nothing contributed more powerfully than the periodical papers published under various titles by Addison[2] and his associates. The

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gardé comme le premier des hommes dans l'art nouveau de repandre de la lumiere et des graces sur les sciences abstraites, et il a eu du merité dans tous les autres genres qu'il a traités. Tant de talens ont éte soutenus par la connoissance des langues et de l'histoire, et *il a été sans contredit au-dessus de tous les sçavans qui n'ont pas eu le don de l'invention.*"

[1] Condorcet has said expressly, that his apathy was confined entirely to what regarded himself, and that he was always an active, though frequently a concealed friend, where his good offices could be useful to those who deserved them. "On a cru Fontenelle insensible, parce que sachant mâitriser les mouvemens de son ame il se conduisoit d'après son esprit, toujours juste et toujours sage. D'ailleurs, il avoit consenti sans peine à conserver cette réputation d'insensibilité; il avoit souffert les plaisanteries de ses societés sur sa froideur, sans chercher à les détromper, parce que, bien sur que les vraies amis n'en seroit pas la dupe, il voyoit dans cette reputation un moyen commode de se délivrer des indifferens sans blesser leur amour propre." (*Eloge de Fontenelle, par Condorcet.*)

Many of Fontenelle's sayings, the import of which must have depended entirely on circumstances of time and place unknown to us, have been absurdly quoted to his disadvantage, in their literal and most obvious acceptation. "I hate war (said he), for it spoils conversation." Can any just inference be drawn from the levity of this convivial sally, against the humanity of the person who uttered it? Or rather, when connected with the characteristical *finesse* of Fontenelle's wit, does it not lead to a conclusion precisely opposite?

[2] Born in 1672, died in 1719.

effect of these in reclaiming the public taste from the licentiousness and grossness introduced into England at the period of the Restoration; in recommending the most serious and important truths by the united attractions of wit, humour, imagination, and eloquence; and, above all, in counteracting those superstitious terrors which the weak and ignorant are so apt to mistake for religious and moral impressions—has been remarked by numberless critics, and is acknowledged even by those who felt no undue partiality in favour of the authors.[1] Some of the papers of Addison, however, are of an order still higher, and bear marks of a mind which, if early and steadily turned to philosophical pursuits, might have accomplished much more than it ventured to undertake. His frequent references to the *Essay on Human Understanding*, and the high encomiums with which they are always accompanied, show how successfully he had entered into the spirit of that work; and how completely he was aware of the importance of its object. The popular nature of his publications, indeed, which rendered it necessary for him to avoid everything that might savour of scholastic or of metaphysical discussion, has left us no means of estimating his philosophical depth, but what are afforded by the *results* of his thoughts on the particular topics which he has occasion to allude to, and by some of his incidental comments on the scientific merits of preceding authors. But these means are sufficiently ample to justify a very high opinion of his sound and unprejudiced judgment, as well as of the extent and correctness of his literary information. Of his powers as a logical reasoner he has not enabled us to form an estimate; but none of his contemporaries seem to have been more completely tinctured with all that is most valuable in the metaphysical and ethical systems of his time.[2]

But what chiefly entitles the name of Addison to a place in this Discourse, is his *Essays on the Pleasures of Imagination;* the first attempt in England to investigate the principles of the fine arts; and an attempt which, notwithstanding many defects in the

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[1] See Pope's *Imitations of Horace*, Book II. Epistle I. "Unhappy Dryden," &c. &c.

[2] I quote the following passage from Addison, *not* as a specimen of his metaphysical acumen, but as a proof of his good sense in divining and obviating a difficulty which I believe most persons will acknowledge occurred to themselves when they first entered on metaphysical studies:—

"Although we divide the soul into several powers and faculties, there is no such division in the soul itself, since it is *the whole soul* that remembers, understands, wills, or imagines. Our manner of considering the memory, understanding, will, imagination, and the like faculties, is for the better enabling us to express ourselves in such abstracted subjects of speculation, not that there is any such division in the soul itself." In another part of the same paper, Addison observes, that "what we call the faculties of the soul are only the different ways or modes in which the soul can exert herself." (*Spectator*, No. 600.)

For some important remarks on the words *Powers* and *Faculties*, as applied to the Mind, see Locke, B. II. Ch. xxi. § 20.

execution, is entitled to the praise of having struck out a new avenue to the study of the human mind, more alluring than any which had been opened before. In this respect, it forms a most important supplement to Locke's *Survey of the Intellectual Powers*; and it has, accordingly, served as a text, on which the greater part of Locke's disciples have been eager to offer their comments and their corrections. The progress made by some of these in exploring this interesting region has been great; but let not Addison be defrauded of his claims as a discoverer.

Similar remarks may be extended to the hints suggested by Addison on Wit, on Humour, and on the Causes of Laughter. It cannot, indeed, be said of him, that he exhausted any one of these subjects; but he had at least the merit of starting them as Problems for the consideration of philosophers; nor would it be easy to name among his successors, a single writer who has made so important a step towards their solution, as the original proposer.

The philosophy of the papers to which the foregoing observations refer, has been pronounced to be slight and superficial, by a crowd of modern metaphysicians who were but ill entitled to erect themselves into judges on such a question.[1] The singular simplicity and perspicuity of Addison's style have contributed much to the prevalence of this prejudice. Eager for the instruction, and unambitious of the admiration of the multitude, he everywhere studies to bring himself down to their level; and even when he thinks with the greatest originality, and writes with the most inimitable felicity, so easily do we enter into the train of his ideas, that we can hardly persuade ourselves that we could not have thought and written in the same manner. He has somewhere said of "fine writing," that it "consists of sentiments which are natural, without being obvious:" and his definition has been applauded by Hume, as at once concise and just. Of the thing defined, his own periodical essays exhibit the most perfect examples.

To this simplicity and perspicuity, the wide circulation which his works have so long maintained among all classes of readers, is in a great measure to be ascribed. His periods are not constructed, like those of Johnson, to "elevate and surprise," by filling the ear and dazzling the fancy; but we close his volumes with greater reluctance, and return to the perusal of them with far greater alacrity. Franklin, whose fugitive publications on political topics have had so extraordinary an influence on public opinion, both in the Old and New Worlds, tells us that his style in writing was formed upon the model of Ad-

[1] See Note (Z.)

dison: Nor do I know anything in the history of his life which does more honour to his shrewdness and sagacity. The copyist, indeed, did not possess the gifted hand of his master,—*Museo contingens cuncta lepore;*—but such is the effect of his plain and seemingly artless manner, that the most profound conclusions of political economy assume, in his hands, the appearance of indisputable truths; and some of them, which had been formerly confined to the speculative few, are already current in every country of Europe, as proverbial maxims.[1]

To touch (however slightly) on Addison's other merits, as a critic, as a wit, as a speculative politician, and, above all, as a moralist, would lead me completely astray from my present object. It will not be equally foreign to it to quote the two following short passages, which, though not strictly *metaphysical*, are, both of them, the result of metaphysical habits of thinking, and bear a stronger resemblance than anything I recollect among the wits of Queen Anne's reign, to the best philosophy of the present age. They approach, indeed, very nearly to the philosophy of Turgot and of Smith.

"Among other excellent arguments for the immortality of the soul, there is one drawn from the perpetual progress of the soul to its perfection, without a possibility of ever arriving at it; which is a hint that I do not remember to have seen opened and improved by others who have written on this subject, though it seems to me to carry a great weight with it. A brute arrives at a point of perfection that he can never pass. In a few years he has all the endowments he is capable of; and were he to live ten thousand more, would be the same thing he is at present. Were a human soul thus at a stand in her accomplishments, were her faculties to be full-blown, and incapable of farther enlargement, I would imagine it might fall away insensibly, and drop at once into a state of annihilation. But can we believe a thinking being, that is in a perpetual progress of improvement, and travelling on from perfection to perfection, after having just looked abroad into the works of its Creator, and made a few discoveries of his infinite goodness, wisdom, and power, must perish at her first setting out, and in the very beginning of her inquiries?"[2]

The philosophy of the other passage is not unworthy of the author of the *Wealth of Nations*. The *thought* may be traced to earlier writers, but certainly it was never before

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[1] The expressions "*Laissez nous faire,*" and "*pas trop gouverner,*" which comprise, in a few words, two of the most important lessons of Political wisdom, are indebted chiefly for their extensive circulation to the short and luminous comments of Franklin. (See his *Political Fragments*, § 4.)

[2] This argument has been prosecuted with great ingenuity and force of reasoning (blended, however, with some of the peculiarities of his Berkeleian metaphysics) by the late Dr. James Hutton. (See his *Investigation of the Principles of Knowledge*, Vol. III. p 195, *et seq.* Edin 1794.)

presented with the same fulness and liveliness of illustration; nor do I know, in all Addison's works, a finer instance of his solicitude for the improvement of his fair readers, than the address with which he here insinuates one of the sublimest moral lessons, while apparently aiming only to amuse them with the geographical history of the muff and the tippet.

"Nature seems to have taken a particular care to disseminate her blessings among the different regions of the world, with an eye to the mutual intercourse and traffic among mankind; that the natives of the several parts of the globe might have a kind of dependance upon one another, and be united together by their common interest. Almost every *degree* produces something peculiar to it. The food often grows in one country, and the sauce in another. The fruits of Portugal are corrected by the products of Barbadoes; the infusion of a China plant, sweetened with the pith of an Indian cane. The Philippine Islands give a flavour to our European bowls. The single dress of a woman of quality is often the product of a hundred climates. The muff and the fan come together from the opposite ends of the earth. The scarf is sent from the torrid zone, and the tippet from beneath the pole. The brocade petticoat rises out of the mines of Peru, and the diamond necklace out of the bowels of Indostan."

But I must not dwell longer on the fascinating pages of Addison. Allow me only, before I close them, to contrast the last extract with a remark of Voltaire, which, shallow and contemptible as it *is*, occurs more than once, both in verse and in prose, in his voluminous writings.

> Il murit a Moka, dans le sable Arabique,
> Ce Caffe nécessaire aux pays des frimats;
> Il met la Fièvre en nos climats,
> Et le remède en Amerique.
>
> (*Epitre au Roi du Prusse*, 1750.)

And yet Voltaire is admired as a philosopher by many who will smile to hear this title bestowed upon Addison!

It is observed by Akenside, in one of the notes to the *Pleasures of Imagination*, that "Philosophy and the Fine Arts can hardly be conceived at a greater distance from each other than at the Revolution, when Locke stood at the head of one party, and Dryden of the other." He observes, also, that "a very great progress towards their re-union had been made within these few years." To this progress the chief impulse was undoubtedly given by Addison and Shaftesbury.

Notwithstanding, however, my strong partiality for the former of these writers, I should be truly sorry to think, with Mr. Hume, that "Addison will be read with plea-

sure when Locke shall be *entirely forgotten.*" (*Essay on the Different Species of Philosophy.*)

A few years before the commencement of these periodical works, a memorable accession was made to metaphysical science, by the publication of Berkeley's *New Theory of Vision;* and of his *Principles of Human Knowledge.* Possessed of a mind which, however inferior to that of Locke in depth of reflection and in soundness of judgment, was fully its equal in logical acuteness and invention, and in learning, fancy, and taste, far its superior,—Berkeley was singularly fitted to promote that re-union of Philosophy and of the Fine Arts which is so essential to the prosperity of both. Locke, we are told, despised poetry; and we know from one of his own letters, that, among our English poets, his favourite author was Sir Richard Blackmore. Berkeley, on the other hand, courted the society of all, from whose conversation and manners he could hope to add to the embellishments of his genius; and although himself a decided and High Church Tory,[1] lived in the habits of friendship with Steele and Addison, as well as with Pope and Swift. Pope's admiration of him seems to have risen to a sort of enthusiasm. He yielded to Berkeley's decision on a very delicate question relating to the exordium of the *Essay on Man;* and on his moral qualities he has bestowed the highest and most unqualified eulogy to be found in his writings.

> "Even in a Bishop I can spy desert,
> Secker is decent; Rundle has a heart;
> Manners with candour are to Benson given,
> To Berkeley every virtue under Heaven."

With these intellectual and moral endowments, admired and blazoned as they were by the most distinguished wits of his age, it is not surprising that Berkeley should have given a popularity and fashion to metaphysical pursuits, which they had never before acquired in England. Nor was this popularity diminished by the boldness of some of his paradoxes: on the contrary, it was in no small degree the *effect* of them; the great bulk of mankind being always prone to mistake a singularity or eccentricity of thinking, for the originality of a creative genius.

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[1] See a volume of Sermons, preached in the chapel of Trinity College, Dublin. See also a Discourse addressed to Magistrates, &c. printed in 1736. In both of these publications, the author carries his Tory principles so far, as to represent the doctrine of passive obedience and non-resistance as an essential article of the Christian faith. "The Christain religion makes every legal constitution sacred, by commanding our submission thereto. *Let every soul be subject to the higher powers* saith St Paul, *for the powers that be are ordained of God.*"

The solid additions, however, made by Berkeley to the stock of human knowledge were important and brilliant. Among these, the first place is unquestionably due to his *New Theory of Vision;* a work abounding with ideas so different from those commonly received, and, at the same time, so profound and refined, that it was regarded by all but a few accustomed to deep metaphysical reflection, rather in the light of a philosophical romance, than of a sober inquiry after truth. Such, however, has been since the progress and diffusion of this sort of knowledge, that the leading and most abstracted doctrines contained in it, form now an essential part of every elementary treatise of optics, and are adopted by the most superficial smatterers in science as fundamental articles of their faith.

Of a theory, the outlines of which cannot fail to be familiar to a great majority of my readers, it would be wholly superfluous to attempt any explanation here, even if it were consistent with the limits within which I am circumscribed. Suffice it to observe, that its chief aim is to distinguish the immediate and natural objects of sight from the *seemingly instantaneous* conclusions which experience and habit teach us to draw from them in our earliest infancy; or (in the more concise metaphysical language of a later period) to draw the line between the *original* and the *acquired perceptions* of the eye. They who wish to study it in detail, will find ample satisfaction, and, (if they have any relish for such studies) an inexhaustible fund of entertainment, in Berkeley's own short but masterly exposition of his principles, and in the excellent comments upon it by Smith of Cambridge; by Porterfield; by Reid; and, still more lately, by the author of the *Wealth of Nations.*[1]

That this doctrine, with respect to the *acquired perceptions* of sight, was quite unknown to the best metaphysicians of antiquity, we have direct evidence in a passage of Aristotle's *Nicomachian Ethics*, where he states the distinction between these endowments which are the immediate gift of nature, and those which are the fruit of custom and habit. In the former class, he ranks the perceptions of sense, mentioning particularly the senses of seeing and of hearing. The passage (which I have transcribed in a *Note*) is curious, and seems to me decisive on the subject.[2]

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[1] By this excellent judge, Berkeley's *New Theory of Vision* is pronounced to be "one of the finest examples of Philosophical Analysis that is to be found in our own, or any other language. (*Essays on Philosophical Subjects.* Lond. 1795, p. 215.)

[2] Ου γαρ εκ του πολλακις ιδειν, η πολλακις ακουσαι, τας αισθησεις ελαβομεν, αλλ' ανεπαλιν, εχοντες εχρησαμεθα, ου χρησαμενοι εσχομεν. (*Ethic. Nicomach.* Lib. ii. cap. 1.)

"For it is not from seeing often, or from hearing often, that we get these senses; but, on the contrary,

The misapprehensions of the ancients on this very obscure question will not appear surprising, when it is considered, that *forty* years after the publication of Berkeley's *Theory of Vision*, and *sixty* years after the date of Locke's *Essay*, the subject was so imperfectly understood in France, that Condillac (who is, to this day, very generally regarded by his countrymen as the father of genuine logic and metaphysics) combated at great length the conclusions of the English philosophers concerning the *acquired* perceptions of sight; affirming that " the eye judges *naturally* of figures, of magnitudes, of situations, and of distances." His argument in support of this opinion is to be found in the sixth section of his *Essay on the Origin of Human Knowledge.*

It is difficult to suppose, that a person of mature years, who had read and studied Locke and Berkeley with as much care and attention as Condillac appears to have bestowed on them, should have reverted to this ancient and vulgar prejudice; without suspecting that his metaphysical depth has been somewhat overrated by the world.[1] It is but justice, however, to Condillac to add, that, in a subsequent work, he had the candour to acknowledge and to retract his error;—a rare example of that disinterested love of truth, which is so becoming in a philosopher. I quote the passage (in a literal, though somewhat abridged version), not only to show, that, in the above statement, I have not misrepresented his opinion, but because I consider this remarkable circumstance in his literary history as a peculiarly amiable and honourable *trait* in his character.

" We cannot recall to our memory the ignorance in which we were born: It is a state

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instead of getting them by using them, we use them because we have got them."

Had Aristotle been at all aware of the distinction so finely illustrated by Berkeley, instead of appealing to the perceptions of these two senses, as instances of endowments coeval with our birth, he would have quoted them as the most striking of all examples, of the effects of Custom in apparently identifying our acquired powers with our original faculties.

[1] Voltaire, at an earlier period, had seized completely the scope of Berkeley's theory; and had explained it with equal brevity and precision, in the following passage of his *Elements of the Newtonian Philosophy:*

" Il faut absolument conclure, que les distances, les grandeurs, les situations ne sont pas, à proprement parler, des choses visibles, c'est a dire, ne sont pas les objets propres et immédiats de la vue. L'objet propre et immédiat de la vue n'est autre chose que la lumière colorée: tout le reste, nous ne le sentons qu'a la longue et par expérience. Nous apprenons à voir, précisément comme nous apprenons à parler et à lire. La difference est, que l'art de voir est plus facile, et que la nature est également à tous notre maitre.

" Les jugemens soudains, presque uniformes, que toutes nos âmes à un certain age portent des distances des grandeurs, des situations, nous font penser, qu'il n'y a qu'à ouvrir les yeux pour voir la manière dont nous voyons. On se trompe, il y faut le secours des autres sens. Si les hommes n'avoient que le sens de la vue, ils n'auroient aucun moyen pour connôitre l'étendue en longeur, largeur et profondeur, et un pur esprit ne la connôitroit peut être, à moins que Dieu ne la lui révélât."—*Phys. Newton*, Chap. 7.

which leaves no trace behind it. We only recollect our ignorance of those things, the knowledge of which we recollect to have acquired; and to remark what we acquire, some previous knowledge is necessary. That memory which now renders us so sensible of the step from one acquisition to another, cannot remount to the first steps of the progress; on the contrary, it supposes them already made; and hence the origin of our disposition to believe them connate with ourselves. To say that we have learnt to see, to hear, to taste, to smell, to touch, appears a most extraordinary paradox. It seems to us that nature gave us the complete use of our senses the moment she formed them, and that we have always made use of them without study, because we are no longer obliged to study in order to use them. I retained these prejudices at the time I published my Essay on the *Origin of Human Knowledge;* the reasonings of Locke on a man born blind, to whom the sense of sight was afterwards given, did not undeceive me; and *I maintained against this philosopher that the eye judges naturally of figures, of sizes, of situations, and of distances.*"—Nothing short of his own explicit avowal could have convinced me, that a writer of so high pretensions and of such unquestionable ingenuity as Condillac, had really commenced his metaphysical career under so gross and unaccountable a delusion.

In bestowing the praise of originality on Berkeley's *Theory of Vision,* I do not mean to say, that the *whole* merit of this Theory is exclusively his own. In this, as in most other cases, it may be presumed, that the progress of the human mind has been gradual: And, in point of fact, it will, on examination, be found, that Berkeley only took up the inquiry where Locke dropped it; following out his principles to their remoter consequences, and placing them in so great a variety of strong and happy lights, as to bring a doctrine till *then* understood but by a few, within the reach of every intelligent and attentive reader. For my own part, on comparing these two philosophers together, I am at a loss whether most to admire the powerful and penetrating sagacity of the one, or the fertility of invention displayed in the illustrations of the other. What can be more clear and forcible than the statement of Locke quoted in the Note below; and what an idea does it convey of his superiority to Condillac, when it is considered, that he anticipated *à priori* the same doctrine which was afterwards confirmed by the fine analysis of Berkeley, and demonstrated by the judicious experiments of Cheselden; while the French metaphysician, with all this accumulation of evidence before him, relapsed into a prejudice transmitted to modern times, from the very infancy of optical science![1]

[1] "We are farther to consider (says Locke), concerning perception, that the ideas we receive by sensa-

I believe it would be difficult to produce from any writer prior to Locke, an equal number of important facts relating to the intellectual phenomena, as well observed, and as unexceptionably described, as those which I have here brought under my reader's eye. It must appear evident, besides, to all who have studied the subject, that Locke has, in this passage, enunciated, in terms the most precise and decided, the same general conclusion

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tion are often in grown people altered by the judgment, without our taking notice of it. When we set before our eyes a round globe, of any uniform colour, *v. g.* gold, alabaster, or jet, it is certain that the idea thereby imprinted in our mind is of a flat circle, variously shadowed, with several degrees of light and brightness coming to our eyes. But we having by use been accustomed to perceive what kind of appearance convex bodies are wont to make in us, what alterations are made in the reflections of light by the difference of the sensible figure of bodies; the judgment presently, by an habitual custom, alters the appearances into their causes, so that, from what truly is variety of shadow or colour, collecting the figure it makes it pass for a mark of figure, and frames to itself the perception of a convex figure, and an uniform colour; when the idea we receive from thence is only a plane variously coloured, as is evident in painting. * * * *

"But this is not, I think, usual in any of our ideas, but those received by sight; * because sight, the most comprehensive of all our senses, conveying to our minds the ideas of lights and colours, which are peculiar only to that sense; and also the far different ideas of space, figure, or motion, the several varieties whereof change the appearances of its proper objects, viz. light and colours, we bring ourselves by use to judge of the one by the other. This, in many cases, by a settled habit in things whereof we have frequent experience, is performed so constantly and so quick, that we take *that* for the perception of our sensation, which is an idea formed by our judgment; so that one, viz. that of sensation, serves only to excite the other, and is scarce taken notice of itself; as a man who reads or hears with attention or understanding, takes little notice of the characters or sounds, but of the ideas that are excited in him by them.

"Nor need we wonder that is done with so little notice, if we consider how very *quick* the actions of the mind are performed, for as itself is thought to take up no space, to have no extension; so its actions seem to require no time, but many of them seem to be crowded into an instant. I speak this in comparison to the actions of the body. Any one may easily observe this in his own thoughts, who will take the pains to reflect on them. How, as it were in an instant, do our minds with one glance see all the parts of a demonstration, which may very well be called a long one, if we consider the time it will require to put it into words, and step by step show it to another? Secondly, we shall not be so much surprised, that this is done in us with so little notice, if we consider how the facility which we get of doing things by a custom of doing makes them often pass in us without our notice. *Habits*, especially such as are begun very early, come at last to produce actions in us, which often escape our observations. How frequently do we in a day cover our eyes with our eye-lids, without perceiving that we are at all in the dark? Men that have by custom got the use of a bye-word, do almost in every sentence pronounce sounds, which, though taken notice of by others, they themselves neither hear nor observe; and, therefore, it is not so strange, that our mind should often change the idea of its *sensation* into that of its *judgment*, and make one serve only to excite the other, without taking notice of it." (Locke's *Works*, Vol. I. p. 123, *et seq.*)

* Mr Locke might, however, have remarked something very *similar* to it in the preceptions of the ear; a very large proportion of its appropriate objects being rather *judged of* than actually *perceived*. In the rapidity (for example) of common conversation, how many syllables, and even words, escape the notice of the most attentive hearer; which syllables and words are so quickly supplied from the relation which they bear to the rest of the sentence, that it is quite impossible to distinguish between the audible and the inaudible sounds! A very palpable instance of this occurs in the difficulty experienced by the most acute ear in catching *proper names* or arithmetical sums, or words borrowed from unknown tongues, the first time they are pronounced.

concerning the effect of constant and early *habits*, which it was the great object of Berkeley's *Theory of Vision* to establish, and which, indeed, gives to that work its chief value, when considered in connection with the Philosophy of the Human Mind.

Berkeley himself, it is to be observed, by no means lay claims to that complete novelty in his *Theory of Vision*, which has been ascribed to it by many who, in all probability, derived their whole information concerning it from the traditional and inexact transcripts of book-making historians. In the introductory sentences of his Essay, he states very clearly and candidly the conclusions of his immediate predecessors on this class of our perceptions; and explains, with the greatest precision, in what particulars his own opinion differs from theirs. "It is, I think, *agreed by all*, that distance, of itself, cannot be seen. For distance being a line directed end-wise to the eye, it projects only one point in the fund of the eye, which point remains invariably the same, whether the distance be longer or shorter.

"I find it also acknowledged, that the estimate we make of the distance of objects *considerably remote*, is rather an act of judgment grounded on *experience*, than of sense. For example, when I perceive a great number of intermediate objects, such as houses, fields, rivers, and the like, which I have experienced to take up a considerable space, I thence form a judgment or conclusion, that the object I see beyond them is at a great distance. Again, when an object appears faint and small, which, at a near distance, I have experienced to make a vigorous and large appearance, I instantly conclude it to be far off. And this, 'tis evident, is the result of *experience;* without which, from the faintness and littleness, I should not have inferred anything concerning the distance of objects.

"But when an object is placed at *so near a distance*, as that the interval between the eyes bears any sensible proportion to it, it is the received opinion that the two optic axes, concurring at the object, do there make an angle, by means of which, according as it is greater or less, the object is perceived to be nearer or farther off.

"There is another way mentioned by the optic writers, whereby they will have us judge of those distances, in respect of which the breadth of the pupil hath any sensible bigness; and that is, the greater or less divergency of the rays, which, issuing from the visible point, do fall on the pupil; that point being judged nearest, which is seen by most diverging rays, and that remoter, which is seen by less diverging rays."

These (according to Berkeley) are the "common and current accounts" given by *mathematicians* of our perceiving *near distances* by sight. He then proceeds to show, that they are unsatisfactory; and that it is necessary, for the solution of this problem, to avail

ourselves of principles borrowed from a higher philosophy: After which, he explains, in detail, his own theory concerning the *ideas* (*sensations*) which, by experience, become *signs* of distance;[1] or (to use his own phraseology) "by which distance is *suggested*[2] to the mind." The result of the whole is, that, "a man born blind, being made to see, would not at first have any idea of distance by sight. *The sun and stars, the remotest objects as well as the nearest, would all seem to be in his Eye, or rather in his Mind.*"[3]

From this quotation it appears, that, before Berkeley's time, philosophers had advanced greatly beyond the point at which Aristotle stopped, and towards which Condillac, in his first publication, made a retrograde movement. Of this progress some of the chief steps may be traced as early as the twelfth century in the Optics of Alhazen;[4] and they may be

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[1] For assisting persons unaccustomed to metaphysical studies to enter into the spirit and scope of Berkeley's *Theory*, the best illustration I know of is furnished by the phenomena of the *Phantasmagoria*. It is sufficient to hint at this application of these phenomena, to those who know anything of the subject.

[2] The word *suggest* is much used by Berkeley in this appropriate and technical sense, not only in his *Theory of Vision*, but in his *Principles of Human Knowledge*, and in his *Minute Philosopher*. It expresses, indeed, the cardinal principle on which his *Theory of Vision* hinges; and is now so incorporated with some of our best metaphysical speculations, that one cannot easily conceive how the use of it was so long dispensed with. Locke (in the passage quoted in the Note, p. 107) uses the word *excite* for the same purpose: but it seems to imply an hypothesis concerning the *mechanism* of the mind, and by no means expresses the fact in question with the same force and precision.

It is remarkable, that Dr Reid should have thought it incumbent on him to apologize for introducing into philosophy a word so familiar to every person conversant with Berkeley's works. "I beg leave to make use of the word *suggestion*, because I know not one more proper to express a power of the mind, which seems entirely to have escaped the notice of philosophers, and to which we owe many of our simple notions which are neither impressions nor ideas, as well as many original principles of belief. I shall endeavour to explain, by an example, what I understand by this word. We all know that a certain kind of sound *suggests* immediately to the mind a coach passing in the street; and not only produces the imagination, but the belief, that a coach is passing. Yet there is no comparing of ideas, no perception of agreements or disagreements to produce this belief; nor is there the least similitude between the sound we hear, and the coach we imagine and believe to be passing."

So far Dr Reid's use of the word coincides exactly with that of Berkeley; but the former will be found to annex to it a meaning more extensive than the latter, by employing it to comprehend not only those *intimations* which are the result of experience and habit; but another class of *intimations* (quite overlooked by Berkeley), those which result from the original frame of the human mind. (See Reid's *Inquiry*, Chap. ii. sec. 7.)

[3] I request the attention of my readers to this last sentence, as I have little doubt that the fact here stated gave rise to the theory which Berkeley afterwards adopted, concerning the non-existence of the material world. It is not, indeed, surprising that a conclusion, so very curious with respect to the objects of sight, should have been, in the first ardour of discovery, too hastily extended to those qualities also which are the appropriate objects of touch.

[4] Alhazen, Lib. ii. NN. 10, 12, 39.

perceived still more clearly and distinctly in various optical writers since the revival of letters; particularly in the *Optica Promota* of James Gregory.[1] Father Malebranche went still farther, and even anticipated some of the *metaphysical* reasonings of Berkeley concerning the means by which experience enables us to judge of the distances of *near* objects. In proof of this, it is sufficient to mention the explanation he gives of the manner in which a comparison of the perceptions of sight and of touch teaches us gradually to estimate by the eye the distances of all those objects which are within reach of our hands, or of which we are accustomed to measure the distance, by walking over the intermediate ground.

In rendering this justice to earlier writers, I have no wish to detract from the originality of Berkeley. With the single exception, indeed, of the passage in Malebranche which I have just referred to, and which it is more than probable was unknown to Berkeley when his theory first occurred to him,[2] I have ascribed to his predecessors nothing more than what he has himself explicitly acknowledged to belong to them. All that I wished to do was, to supply some links in the historical chain, which he has omitted.

The influence which this justly celebrated work has had, not only in perfecting the theory of optics, but in illustrating the astonishing effects of early habit on the mental phenomena in general, will sufficiently account to my intelligent readers for the length to which the foregoing observations upon it have extended.

Next in point of importance to Berkeley's New Theory of Vision, which I regard as by far the most solid basis of his philosophical fame, may be ranked his speculations concerning the Objects of General Terms and his celebrated argument against the existence of the Material World. On both of these questions I have elsewhere explained my own ideas so fully, that it would be quite superfluous for me to resume the consideration of them here.[3] In neither instance are his reasonings so entirely original as has been commonly supposed. In the former, they coincide in substance, although with immense improvements in the form, with those of the scholastic nominalists, as revived and modified by Hobbes and Leibnitz. In the latter instance, they amount to little more than an ingenious and elegant developement of some principles of Malebranche, pushed to certain paradoxical but obvious consequences, of which Malebranche, though unwilling to avow them, appears to have been fully aware. These consequences, too, had been previously pointed out by

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[1] See the end of Prop. 28.

[2] Berkeley's *Theory* was published when he was only twenty-five; an age when it can scarcely be supposed that his metaphysical reading had been very extensive.

[3] See *Philosophical Essays*.

Mr Norris, a very learned divine of the Church of England, whose name has unaccountably failed in obtaining that distinction to which his acuteness as a logician, and his boldness as a theorist, justly entitled him.[1]

The great object of Berkeley in maintaining his system of idealism, it may be proper to remark in passing, was to cut up by the roots the scheme of materialism. "Matter (he tells us himself) being once *expelled out of nature*, drags with it so many sceptical and impious notions. * * * * Without it, your Epicureans, Hobbists, and the like, have not even the shadow of a pretence, but become the most cheap and easy triumph in the world."

Not satisfied with addressing these abstract speculations to the learned, Berkeley conceived them to be of such moment to human happiness, that he resolved to bring them, if possible, within the reach of a wider circle of readers, by throwing them into the more popular and amusing form of dialogues.[2] The skill with which he has executed this very difficult and unpromising task cannot be too much admired. The characters of his speakers are strongly marked and happily contrasted; the illustrations exhibit a singular combination of logical subtilty and of poetical invention; and the style, while it everywhere abounds with the rich, yet sober colourings of the author's fancy, is perhaps superior, in point of purity and of grammatical correctness, to any English composition of an earlier date.[3]

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[1] Another very acute metaphysician of the same church (Arthur Collier, author of a *Demonstration of the Non-existence and Impossibility of an External World*) has met with still greater injustice. His name is not to be found in any of our Biographical Dictionaries. In point of date, his publication is some years posterior to that of Norris, and therefore it does not possess the same claims to originality; but it is far superior to it in logical closeness and precision, and is not obscured to the same degree with the mystical theology which Norris (after the example of Malebranche) connected with the scheme of Idealism. Indeed, when compared with the writings of Berkeley himself, it yields to them less in force of argument, than in composition and variety of illustration. The title of Collier's book is *Clavis Universalis*, or a New Inquiry after Truth, being a Demonstration, &c. &c. By Arthur Collier, Rector of Langford Magna, near Sarum. (Lond. printed for Robert Gosling, at the Mitre and Crown, against St Dunstan's Church, Fleet Street, 1713.) The motto prefixed by Collier to his work is from Malebranche, and is strongly characteristical both of the English and French *Inquirer after Truth*. "Vulgi assensus et approbatio circa materiam difficilem est certum argumentum falsitatis istius opinionis cui assentitur." (*Maleb. De Inquir. Verit.* Lib. iii. p. 194.) See Note (AA.)

[2] I allude here chiefly to *Alciphron*, or the *Minute Philosopher*; for as to the dialogues between *Hylas* and *Philonous*, they aspire to no higher merit than that of the common dialogues between A. and B.; being merely a compendious way of stating and of obviating the principal objections which the author anticipated to his opinions.

[3] Dr Warton, after bestowing high praise on the *Minute Philosopher*, excepts from his encomium "those passages in the fourth dialogue, where the author has introduced his fanciful and whimsical opinions about

The impression produced in England by Berkeley's Idealism was not so great as might have been expected; but the novelty of his paradoxes attracted very powerfully the attention of a set of young men who were then prosecuting their studies at Edinburgh, and who formed themselves into a Society for the express purpose of soliciting from the author an explanation of some parts of his theory which seemed to them obscurely or equivocally expressed. To this correspondence the amiable and excellent prelate appears to have given every encouragement; and I have been told by the best authority, that he was accustomed to say, that his reasonings had been nowhere better understood than by this club of young Scotsmen.[1] The ingenious Dr Wallace, author of the *Discourse on the Numbers of Mankind,* was one of the leading members; and with him were associated several other individuals, whose names are now well known and honourably distinguished in the learned world. Mr Hume's *Treatise of Human Nature,* which was published in 1739, affords sufficient evidence of the deep impression which Berkeley's writings had left upon his mind; and to this juvenile essay of Mr Hume's may be traced the origin of the most important metaphysical works which Scotland has since produced.

It is not, however, my intention to prosecute farther, at present, the history of Scottish philosophy. The subject may be more conveniently, and I hope advantageously resumed, after a slight review of the speculations of some English and French writers, who, while they professed a general acquiescence in the doctrines of Locke, have attempted to modify his fundamental principles in a manner totally inconsistent with the views of their master. The remarks which I mean to offer on the modern French school will afford me, at the same time, a convenient opportunity of introducing some strictures on the metaphysical systems which have of late prevailed in other parts of the Continent.

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vision."—(*Essay on the Writings and Genius of Pope,* Vol. II. p. 264.)—If I were called on to point out the most ingenious and original part of the whole work, it would be the argument contained in the passages here so contemptuously alluded to, by this learned and (on all questions of taste) most respectable critic.

[1] The authority I here allude to is that of my old friend and preceptor, Dr John Stevenson, who was himself a member of the *Rankenian* Club, and who was accustomed for many years to mention this fact in his *Academical Prelections.*

SECTION V.

Hartleian School.

THE English writers to whom I have alluded in the last paragraph, I shall distinguish by the title of Dr Hartley's School; for although I by no means consider this person as the first author of any of the theories commonly ascribed to him (the seeds of all of them having been previously sown in the university where he was educated), it was nevertheless reserved for him to combine them together, and to exhibit them to the world in the imposing form of a system.

Among the immediate predecessors of Hartley, Dr Law, afterwards Bishop of Carlisle, seems to have been chiefly instrumental in preparing the way for a schism among Locke's disciples. The name of Law was first known to the public by an excellent translation, accompanied by many learned, and some very judicious notes, of Archbishop King's work on the Origin of Evil; a work of which the great object was to combat the Optimism of Leibnitz, and the Manicheism imputed to Bayle. In making this work more generally known, the translator certainly rendered a most acceptable and important service to the world, and, indeed, it is upon this ground that his best claim to literary distinction is still founded.[1] In his own original speculations, he is weak, paradoxical, and oracular;[2] af-

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[1] King's argument in proof of the prevalence in this world, both of Natural and Moral Good, over the corresponding Evils, has been much and deservedly admired; nor are Law's Notes upon this head entitled to less praise. Indeed, it is in this part of the work that both the author and his commentator appear, in my opinion, to the greatest advantage.

[2] As instances of this I need only refer to the *first* and *third* of his Notes on King: the former of which relates to the word *substance;* and the latter to the dispute between Clarke and Leibnitz concerning *space.* His reasonings on both subjects are obscured by an affected use of hard and unmeaning words, ill becoming so devoted an admirer of Locke. The same remark may be extended to an *Inquiry into the Ideas of Space and Time,* published by Dr Law in 1734.

The result of Law's speculations on Space and Time is thus stated by himself: "That our ideas of them do not imply any external *ideatum* or *objective* reality; that these ideas (as well as those of *infinity* and *number*) are *universal* or *abstract* ideas, existing under that *formality* no where but in the mind; nor affording a proof of any thing, but of the power which the mind has to form them." (Law's *Trans. of King,* p. 7. 4th edit.) This language, as we shall afterwards see, approaches very nearly to that lately introduced by Kant. Dr Law's favourite author might have cautioned him against such jargon. (See *Essay on the Human Understanding,* Book II. Chap. xiii. § 17, 18.)

The absurd application of the scholastic word *substance* to empty space; an absurdity in which the powerful

fecting, on all occasions, the most profound veneration for the opinions of Locke, but much more apt to attach himself to the errors and oversights of that great man, than to enter into the general spirit of his metaphysical philosophy.

To this translation, Dr. Law prefixed a Dissertation concerning the Fundamental Principle of Virtue, by the Reverend Mr Gay; a performance of considerable ingenuity, but which would now be entitled to little notice, were it not for the influence it appears to have had in suggesting to Dr Hartley the possibility of accounting for all our intellectual pleasures and pains, by the single principle of the Association of Ideas. We are informed by Dr Hartley himself, that it was in consequence of hearing some account of the contents of this dissertation, he was first led to engage in those inquiries which produced his celebrated *Theory of Human Nature*.

The other principle on which this theory proceeds (that of the vibrations and vibratiuncles in the medullary substance of the brain) is also of Cambridge origin. It occurs in the form of a query in Sir Isaac Newton's *Optics;* and a distinct allusion to it, as a principle likely to throw new light on the phenomena of mind, is to be found in the concluding sentence of Smith's *Harmonics*.

Very nearly about the time when Hartley's *Theory* appeared, Charles Bonnet of Geneva published some speculations of his own, proceeding almost exactly on the same assumptions. Both writers speak of vibrations *(ébranlemens)* in the nerves; and both of them have recourse to a subtile and elastic ether, co-operating with the nerves in carrying on the communication between soul and body.[1] This fluid Bonnet conceived to be contained in the nerves, in a manner analogous to that in which the electric fluid is contained in the solid bodies which conduct it; differing in this respect from the Cartesians as well as from the ancient physiologists, who considered the nerves as hollow tubes, or pipes, within which the animal spirits were included. It is to this elastic ether that Bonnet ascribes the vibrations of which he supposes the nerves to be susceptible; for the nerves themselves (he justly observes) have no resemblance to the stretched cords of a musical instrument.[2]

mind of Gravesande acquiesced many years after the publication of the *Essay on Human Understanding*, has probably contributed not a little to force some authors into the opposite extreme of maintaining, with Leibnitz and Dr Law, that our idea of space does not imply any external *ideatum* or objective reality. Gravesande's words are these: "Substantiæ sunt aut cogitantes, aut non cogitantes; cogitantes duas novimus, Deum et Mentem nostram: præter has et alias d... in dubium non revocamus. Duæ etiam substantiæ, quæ non cogitant, nobis notæ sunt Spatium et Corpus."—Gravesande, *Introd. ad Philosophiam*, § 19.

[1] *Essai Analytique de l'Ame*, Chap. v. See also the additional notes on the first chapter of the seventh part of the *Contemplation de la Nature*.

[2] "Mais les nerfs sont mols, ils ne sont point tendus comme les cordes d'un instrument; les objets y

Hartley's *Theory* differs in one respect from this, as he speaks of vibrations and vibratiuncles in the medullary substance of the brain and nerves. He agrees, however, with Bonnet in thinking, that to these vibrations in the nerves the co-operation of the ether is essentially necessary; and, therefore, at bottom the two hypothesis may be regarded as in substance the same. As to the trifling shade of difference between them, the advantage seems to me to be in favour of Bonnet.

Nor was it only in their Physiological Theories concerning the nature of the union between soul and body, that these two philosophers agreed. On all the great articles of metaphysical theology, the coincidence between their conclusions is truly astonishing. Both held the doctrine of Necessity in its fullest extent; and both combined with it a vein of mystical devotion, setting at defiance the creeds of all established churches. The intentions of both are allowed, by those who best knew them, to have been eminently pure and worthy; but it cannot be said of either, that his metaphysical writings have contributed much to the instruction or to the improvement of the public. On the contrary, they have been instrumental in spreading a set of speculative tenets very nearly allied to that sentimental and fanatical modification of Spinozism, which, for many years past, has prevailed so much, and produced such mischievous effects in some parts of Germany.

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exciteroient-ils donc les vibrations analogues à celle d'une corde pincée? Ces vibrations se communiqueroient-elles à l'instant au siège de l'ame? La chose paroit difficile à conçevoir. Mais si l'on admet dans les nerfs un fluide dont la subtilité et l'élasticité approche de celle de la lumière ou de l'éther, on expliquera facilement par le secours de ce fluide, et la célérité avec laquelle les impressions se communiquent à l'ame, et celle avec laquelle l'âme éxécute tant d'operations différentes." (*Essai Anal.* Chap. v.)

"Au reste, les physiologistes qui avoient cru que les filets nerveux étoient solides, avoient cédé à des apparences trompeuses. Ils vouloient d'ailleurs faire osciller les nerfs pour rendre raison des sensations, et les nerfs ne peuvent osciller. Ils sont mous, et nullement élastiques. Un nerf coupé ne se retire point. C'est le fluide invisible que les nerfs renferment, qui est doué de cette élasticité qu'on leur attribuoit, et d'une plus grande élasticité encore." (*Contemp. de la Nature*, VII. Partie, Chap. i. Note at the end of the chapter.)

M. Quesnai, the celebrated author of the *Economical System*, has expressed himself to the same purpose concerning the supposed vibrations of the nerves: "Plusieurs physiciens ont pensé que le seul ébranlement des nerfs, causé par les objets qui touchent les organes des corps, suffit pour occasioner le mouvement et le sentiment dans les parties ou les nerfs sont ébranlés. Ils se representent les nerfs comme des cordes fort tendus, qu'un léger contact met en vibration dans toute leur étendue. Des philosophes, peu instruits en anatomie, ont pu se former une telle idée . . . . . : Mais cette tension qu'on suppose dans les nerfs, et qui les rend si susceptibles, d'ébranlement et de vibration, est si grossièrement imaginée qu'il seroit ridicule de s'occuper sérieusement à la refuter." (*Econ. Animale*, sect. 3. c. 13.)

As this passage from Quesnai is quoted by Condillac, and sanctioned by his authority (*Traité des Animaux*, Chap. iii.), it would appear that the hypothesis which supposes the nerves to perform their functions by means of vibrations was going fast into discredit, both among the metaphysicians and the physiologists of France, at the very time when it was beginning to attract notice in England, in consequence of the visionary speculations of Hartley.

But it is chiefly by his application of the associating principle to account for all the mental phenomena that Hartley is known to the world; and upon this I have nothing to add to what I have already stated in another work. (*Phil. Essays*, Essay IV.) His Theory seems to be already fast passing into oblivion; the temporary popularity which it enjoyed in this country having, in a great measure, ceased with the life of its zealous and indefatigable apostle Dr Priestley.[1]

It would be unfair, however, to the translator of Archbishop King, to identify his opinions with those of Hartley and Priestley. The zeal with which he contends for man's free agency is sufficient, of itself, to draw a strong line of distinction between his Ethical System and their's. (See his Notes on King, *passim.*) But I must be allowed to say of him, that the general scope of his writings tends, in common with that of the two other metaphysicians, to depreciate the evidences of Natural Religion, and more especially to depreciate the evidences which the light of nature affords of a life to come; "a doctrine equally necessary to comfort the weakness, and to support our lofty ideas of the grandeur of human nature;"[2] and of which it seems hard to confine exclusively the knowledge to that portion of mankind who have been favoured with the light of Revelation. The influence of the same fundamental error, arising, too, from the same mistaken idea, of thus strengthening the cause of Christianity, may be traced in various passages of the posthumous work of the late Bishop of Llandaff. It is wonderful that the reasonings of Clarke and of Butler did not teach these eminent men a sounder and more consistent logic; or, at least, open their eyes to the inevitable consequences of the rash concessions which they made to their adversaries.[3]

Among the disciples of Law, one illustrious exception to these remarks occurs in Dr

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[1] Dr Priestley's opinion of the merits of Hartley's work is thus stated by himself: "Something was done in this field of knowledge by Descartes, very much by Mr Locke, but most of all by Dr Hartley, who has thrown more useful light upon the theory of the mind, than Newton did upon the theory of the natural world." (*Remarks on Reid, Beattie, and Oswald*, p. 2. London, 1774.)

[2] Smith's *Theory of Moral Sentiments*, 6th Ed. Vol. I. pp. 325, 326.

Dr Law's doctrine of the sleep of the soul, to which his high station in the church could not fail to add much weight in the judgment of many, is, I believe, now universally adopted by the followers of Hartley and Priestley; the theory of vibrations being evidently inconsistent with the supposition of the soul's being able to exercise her powers in a separate state from the body.

[3] Without entering at all into the argument with Dr Law or his followers, it is sufficient here to mention, as as an historical fact, their wide departure from the older lights of the English church, from Hooker downwards. "All religion (says Archbishop Tillotson, whom I select as an unexceptionable organ of their common sentiments) is founded on right notions of God and his perfections, insomuch that Divine Revelation

Paley, whose treatise on Natural Theology is unquestionably the most instructive as well as interesting publication on that subject which has appeared in our times. As the book was intended for popular use, the author has wisely avoided, as much as possible, all metaphysical discussions; but I do not know that there exists any other work where the argument from *final causes* is placed in so great a variety of pleasing and striking points of view.

SECTION VI.

Condillac, and other French Metaphysicians of a later date.

WHILE Hartley and Bonnet were indulging their imagination in theorizing concerning the nature of the union between soul and body, Condillac was attempting to draw the attention of his countrymen to the method of studying the phenomena of Mind recommended and exemplified by Locke.[1] Of the vanity of expecting to illustrate, by physiolo-

itself does suppose these for its foundations; and can signify nothing to us unless they be first known and believed; so that the principles of natural religion are the foundation of that which is revealed." (Sermon 41.) "There is an intrinsical good and evil in things, and the reasons and respects of moral good and evil are fixed and immutable, eternal and indispensable. Nor do they speak safely who make the Divine will the rule of moral good and evil, as if there were nothing good or evil in its own nature antecedently to the will of God; but, that all things are therefore good and evil because God wills them to be so." (Sermon 88.) "Natural religion is obedience to the natural law, and the performance of such duties as natural light, without any express and supernatural revelation, doth dictate to men. These lie at the bottom of all religion, and are the great fundamental duties which God requires of all mankind. These are the surest and most sacred of all other laws; those which God hath rivetted in our souls and written upon our hearts; and these are what we call moral duties, and most valued by God, which are of eternal and perpetual obligation, because they do naturally oblige, without any particular and express revelation from God; and these are the foundation of revealed and instituted religion; and all revealed religion does suppose them and build upon them." Sermons 48, 49.

[1] It may appear to some unaccountable, that no notice should have been taken, in this Dissertation, of any French metaphysician during the long interval between Malebranche and Condillac. As an apology for this apparent omission, I beg leave to quote the words of an author intimately acquainted with the history of French literature and philosophy, and eminently qualified to appreciate the merits of those who have contributed to their progress. "If we except (says Mr. Adam Smith, in a *Memoir* published in 1755) the Meditations of Descartes, I know of nothing in the works of French writers which aspires at originality in morals or metaphysics; for the philosophy of Regius and that of Malebranche are nothing more than the meditations of Descartes, unfolded with more art and refinement. But Hobbes, Locke, Dr Mandeville, Lord Shaftesbury, Dr Butler, Dr Clarke, and Mr Hutcheson, each in his own system, all different and all incompatible, have tried to be original, at least in some points. They have attempted to add something to the fund of observations collected by their

gical conjectures, the manner in which the intercourse between the thinking principle and the external world is carried on, no philosopher seems ever to have been more completely aware; and, accordingly, he confines himself strictly, in all his researches concerning this intercourse, to an examination of the general laws by which it is regulated. There is, at the same time, a remarkable coincidence between some of his views and those of the other two writers. All of the three, while they profess the highest veneration for Locke, have abandoned his account of the origin of our ideas for that of Gassendi; and, by doing so, have, with the best intentions, furnished arms against those principles which it was their common aim to establish in the world.[1] It is much to be regretted, that by far the greater part of those French writers who have since speculated about the human mind, have acquired the whole of their knowledge of Locke's philosophy through this mistaken comment upon its fundamental principle. On this subject I have already exhausted all that I have to offer on the effect of Condillac's writings; and I flatter myself have sufficiently shown how widely his commentary differs from the text of his author. It is this commentary, however, which is now almost universally received on the Continent as the doctrine of Locke, and which may justly be regarded as the sheet-anchor of those systems which are commonly stigmatised in England with the appellation of French philosophy. Had Condillac been sufficiently aware of the consequences which have been deduced (and I must add *logically* deduced) from his account of the origin of our knowledge, I am per-

predecessors, and already the common property of mankind. This branch of science, which the English themselves neglect at present, appears to have been recently transported into France. I discovered some traces of it not only in the *Encyclopédie*, but in the *Theory of Agreeable Sensations*, by M. de Pouilly, and much more in the late discourse of M. Rousseau, *On the Origin and Foundation of the Inequality of Ranks among Men.*"

Although I perfectly agree with Mr Smith in his general remark on the sterility of invention among the French metaphysicians posterior to Descartes, when compared to those of England, I cannot pass over the foregoing quotation without expressing my surprise, 1*st*, To find the name of Malebranche (one of the highest in modern philosophy) degraded to a level with that of Regius; and, 2*dly*, To observe Mr Smith's silence with respect to Buffier and Condillac, while he mentions the author of the *Theory of Agreeable Sensations* as a metaphysician of original genius. Of the merits of Condillac, whose most important works were published several years before this paper of Mr Smith's, I am about to speak in the text; and those of Buffier I shall have occasion to mention in a subsequent part of this discourse. In the mean time, I shall only say of him, that I regard him as one of the most original as well as sound philosophers of whom the eighteenth century has to boast.

[1] Condillac's earliest work appeared three years before the publication of Hartley's *Theory*. It is entitled, "*Essai sur l'Origine des Connoissances Humaines. Ouvrage où l'on réduit à un seul principe tout ce qui concerne l'entendement humain.*" This *seul principe* is the association of ideas. The account which both authors give of the transformation of sensations into ideas is substantially the same.

suaded, from his known candour and love of truth, that he would have been eager to acknowledge and to retract his error.

In this apparent simplification and generalization of Locke's doctrine, there is, it must be acknowledged, something, at first sight, extremely seducing. It relieves the mind from the painful exercise of abstracted reflection, and amuses it with analogy and metaphor when it looked only for the severity of logical discussion. The clearness and simplicity of Condillac's style add to the force of this illusion, and flatter the reader with an agreeable idea of the powers of his own understanding, when he finds himself so easily conducted through the darkest labyrinths of metaphysical sciences. It is to this cause I would chiefly ascribe the great popularity of his works. They may be read with as little exertion of thought as a history or a novel; and it is only when we shut the book, and attempt to express in our own words, the substance of what we have gained, that we have the mortification to see our supposed acquisitions vanish into air.

The philosophy of Condillac was, in a more peculiar manner, suited to the taste of his own country, where (according to Mad. de Stael) "few read a book but with a view to talk of it."[1] Among such a people, speculations which are addressed to the power of reflection can never expect to acquire the same popularity with theories expressed in a metaphorical language, and constantly recalling to the fancy the impressions of the external senses. The state of society in France, accordingly, is singularly unfavourable to the inductive philosophy of the human mind; and of this truth no proof more decisive can be produced, than the admiration with which the metaphysical writings of Condillac have been so long regarded.

On the other hand, it cannot be denied that Condillac has, in many instances, been eminently successful, both in observing and describing the mental phenomena; but, in such cases, he commonly follows Locke as his guide; and, wherever he trusts to his own judgment, he seldom fails to wander from his way. The best part of his works relates to the action and reaction of thought and language on each other, a subject which had been previously very profoundly treated by Locke, but which Condillac has had the merit of placing in many new and happy points of view. In various cases, his conclusions are pushed too far; and in others are expressed without due precision; but, on the whole, they form a most valuable accession to this important branch of logic; and (what not a

[1] "En France, on ne lit guère un ouvrage que pour en parler." (*Allemagne*, Tom. I. p. 292.) The same remark, I am much afraid, is becoming daily more and more applicable to our own island.

little enhances their value) they have been instrumental in recommending the subject to the attention of other inquirers, still better qualified than their author to do it justice.

In the speculation, too, concerning the origin and the theoretical history of language, Condillac was one of the first who made any considerable advances; nor does it reflect any discredit on his ingenuity, that he has left some of the principal difficulties connected with the inquiry very imperfectly explained. The same subject was soon after taken up by Mr Smith, who, I think, it must be owned, has rather slurred over these difficulties, than attempted to remove them; an omission on his part the more remarkable, as a very specious and puzzling objection had been recently stated by Rousseau, not only to the theory of Condillac, but to all speculations which have for their object the solution of the same problem. "If language" (says Rousseau) "be the result of human convention, and if words be essential to the exercise of thought, language would appear to be necessary for the invention of language."[1]—"But" (continues the same author) "when, by means *which I cannot conceive*, our new grammarians began to extend their ideas, and to generalize their words, their ignorance must have confined them within very narrow bounds. . . . . . . How, for example, could they imagine or comprehend such words as matter, mind, substance, mode, figure, motion, since our philosophers, who have so long made use of them, scarcely understand them, and since the ideas attached to them, being purely metaphysical, can have no model in nature?"

"I stop at these first steps" (continues Rousseau), "and entreat my judges to pause, and consider the distance between the easiest part of language, the invention of physical substantives, and the power of expressing all the thoughts of man, so as to speak in public, and influence society. I entreat them to reflect upon the time and knowledge it must have required to discover numbers, abstract words, aorists, and all the tenses of verbs, particles, syntax, the art of connecting propositions and arguments, and how to form the whole logic of discourse. As for myself, alarmed at these multiplying difficulties, and convinced of the almost demonstrable impossibility of language having been formed and established by means merely human, I leave to others the discussion of the problem, "Whether a so-

[1] That men could never have invented an artificial language, if they had not possessed a natural language, is an observation of Dr Reid's; and it is this indisputable and self-evident truth which gives to Rousseau's remark that imposing plausibility, which, at first sight, dazzles and perplexes the judgment. I by no means say, that the former proposition affords a key to *all* the difficulties suggested by the latter; but it advances us at least one important step towards their solution.

ciety already formed was more necessary for the institution of language, or a language, already invented for the establishment of society?'"[1]

Of the various difficulties here enumerated, *that* mentioned by Rousseau, in the last sentence, was plainly considered by him as the greatest of all; or rather as comprehending under it all the rest. But this difficulty arises merely from his own peculiar and paradoxical theory about the artificial origin of society; a theory which needs no refutation, but the short and luminous aphorism of Montesquieu, that "man is born in society, and there he remains." The other difficulties touched upon by Rousseau, in the former part of this quotation, are much more serious, and have never yet been removed in a manner completely satisfactory: And hence some very ingenious writers have been led to conclude, that language could not possibly have been the work of human invention. This argument has been lately urged with much acuteness and plausibility by Dr Magee of Dublin, and by M. de Bonald of Paris.[2] It may, however, be reasonably questioned, if these philosophers would not have reasoned more logically, had they contented themselves with merely affirming, that the problem has not yet been solved, without going so far as to pronounce it to be absolutely insolvable. For my own part, when I consider its extreme difficulty, and the short space of time during which it has engaged the attention of the learned, I am more disposed to wonder at the steps which have been already gained in the research, than at the number of *desiderata* which remain to employ the ingenuity of our successors. It is justly remarked by Dr Ferguson, that, "when language has attained to that perfection to which it arrives in the progress of society, the speculative mind, in comparing the first and the last stages of the progress, feels the same sort of amazement with a traveller, who, after rising insensibly on the slope of a hill, comes to look down from a precipice, to the summit of which he scarcely believes he could have ascended without supernatural aid."[3]

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[1] *Discours sur l'origine et les fondemens de l'inégalité parmi les hommes.*

[2] The same theory has been extended to the art of writing; but if *this* art was first taught to man by an express revelation from Heaven, what account can be given of its present state in the great empire of China? Is the mode of writing practised there of divine or of human origin?

[3] *Principles of Political and Moral Science*, Vol. I. p. 43. Edin. 1792. To this observation may be added, by way of comment, the following reflections of one of the most learned prelates of the English church: "Man, we are told, had a language from the beginning; for he conversed with God, and gave to every animal its particular name. But how came man by language? He must either have had it from *inspiration*, ready formed from his Creator, or have *derived* it by the exertion of those faculties of the mind, which were implanted in him as a rational creature, from natural and external objects with which he was surrounded. Scripture is silent on the means by which it was acquired. We are not, therefore, warranted to affirm, that it was re-

With respect to some of the difficulties pointed out by Rousseau and his commentators, it may be here remarked in passing (and the observation is equally applicable to various passages in Mr Smith's dissertation on the same subject), that the difficulty of explaining the theory of any of our intellectual operations affords no proof of any difficulty in applying that operation to its proper practical purpose; nor is the difficulty of explaining the metaphysical nature of any part of speech a proof, that, in its first origin, it implied any extraordinary effort of intellectual capacity. How many metaphysical difficulties might be raised about the mathematical notion of a *line*? And yet this notion is perfectly comprehended by every peasant, when he speaks of the distance between two places; or of the length, breadth, or heighth of his cottage. In like manner, although it may be difficult to give a satisfactory account of the origin and import of such words, as *of* or *by*, we ought not to conclude, that the invention of them implied any metaphysical knowledge in the individual who first employed them.[1] Their import, we see, is fully understood by children of three or four years of age.

In this view of the History of Language I have been anticipated by Dr Ferguson. "Parts of speech" (says this profound and original writer), "which, in speculation, cost

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ceived by *inspiration*, and there is no internal evidence in language to lead us to such a supposition. On this side, then, of the question, we have nothing but uncertainty; but on a subject, the causes of which are so remote, nothing is more convenient than to refer them to *inspiration*, and to recur to that easy and comprehensive argument,

Διος δ' ετελειετο βουλη·

that is, man enjoyed the great privilege of speech, which distinguished him at first, and still continues to distinguish him as a *rational* creature, so eminently from the brute creation, without exerting those *reasoning* faculties, by which he was in *other* respects enabled to raise himself so much above their level. Inspiration, then, seems to have been an argument adopted and made necessary by the difficulty of accounting for it otherwise; and the name of inspiration carries with it an awfulness, which forbids the unhallowed approach of inquisitive discussion." (*Essay on the Study of Antiquities*, by Dr. Burgess, 2d edit. Oxford, 1782. Pp. 85, 86.)

It is farther remarked very sagaciously, and I think very decisively, by the same author, that "the supposition of man having received a language ready formed from his Creator, is *actually* inconsistent with the evidence of the origin of our ideas, which exists in language. For, as the origin of our ideas is to be traced in the words through which the ideas are conveyed, so the origin of language is referable to the source from whence our *(first)* ideas are derived, namely, *natural* and *external* objects." (*Ibid.* pp. 83, 84.)

[1] In this remark I had an eye to the following passage in Mr. Smith's dissertation: "It is worth while to observe, that those prepositions, which, in modern languages, hold the place of the ancient cases, are, of all others, the most general and abstract, and metaphysical; *and, of consequence, would probably be the last invented.* Ask any man of common acuteness, what relation is expressed by the preposition *above*? He will readily answer, that of *superiority*. By the preposition *below*? He will as quickly reply, that of *inferiority*. But ask him what relation is expressed by the preposition *of*? and, if he has not beforehand employed his thoughts a good deal upon these subjects, you may safely allow him a week to consider of his answer."

the grammarian so much study, are, in practice, familiar to the vulgar. The rudest tribes, even the idiot and the insane, are possessed of them. They are soonest learned in childhood, insomuch that we must suppose human nature, in its lowest state, competent to the use of them; and, without the intervention of uncommon genius, mankind, in a succession of ages, qualified to accomplish in detail this amazing fabric of language, which, when raised to its height, appears so much above what could be ascribed to any simultaneous effort of the most sublime and comprehensive abilities."[1]

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[1] The following judicious reflections, with which M. Raynouard concludes the introduction to his *Elémens de la Langue Romane*, may serve to illustrate some of the above observations. The modification of an existing language is, I acknowledge, a thing much less wonderful than the formation of a language entirely new; but the processes of thought, it is reasonable to think, are, in both cases, of the same kind; and the consideration of the one is at least a step gained towards the elucidation of the other.

" La langue Romane est peut-être la seule à la formation de laquelle il soit permis de remonter ainsi, pour découvrir et expliquer le secret de son industrieux mécanisme. . . . J'ose dire que l'esprit philosophique, consulté sur le choix des moyens qui devraient épargner à l'ignorance beaucoup d'études penibles et fastidieux, n'eut pas été aussi heureux que l'ignorance elle-même; il est vrai qu'elle avoit deux grands maîtres; la NECESSITE' et le TEMS.

" En considerant à quelle époque d'ignorance et de barbarie s'est formé et perfectionné ce nouvel idiome d'après des principes indiqués seulement par l'analogie et l'euphonie, on se dira peut-être comme je me le suis dit; l'homme porte en soi-même les principes d'une logique naturelle, d'un instinct regulateur, que nous admirons quelquefois dans les enfans. Oui, la providence nous a dôté de la faculté indestructible et des moyens ingenieux d'exprimer, de communiquer, d'éterniser par la parole, et par les signes permanens ou elle se reproduit, cette pensée qui est l'un de nos plus beaux attributs, et qui nous distingue si éminemment et si avantageusement dans l'ordre de la creation." (*Elémens de la Grammaire de la Langue Romane avant l'An.* 1000. Pp. 104, 105, à Paris, 1816.)

In the theoretical history of language, it is more than probable, that some steps will remain to exercise the ingenuity of our latest posterity. Nor will this appear surprising, when we consider how impossible it is for us to judge, from our own experience, of the intellectual processes which pass in the minds of savages. Some instincts, we know, possessed both by them and by infants (that of imitation, for example, and the use of natural signs), disappear in by far the greater number of individuals, almost entirely in the maturity of their reason. It does not seem at all improbable, that other instincts connected with the invention of speech may be confined to that state of the intellectual powers which requires their guidance; nor is it quite impossible, that some latent capacities of the understanding may be evolved by the pressure of necessity. The facility with which infants surmount so many grammatical and metaphysical difficulties, seems to me to add much weight to these conjectures.

In tracing the first steps of the invention of language, it ought never to be forgotten, that we undertake a task more similar than might at first be supposed, to that of tracing the first operations of the infant mind. In both cases, we are apt to attempt an explanation from reason alone, of what requires the co-operation of very different principles. To trace the theoretical history of geometry, in which we know for certain, that all the transitions have depended on *reasoning* alone, is a problem which has not yet been completely solved. Nor has even any satisfactory account been hitherto given of the experimental steps by which men were gradually led to the use of iron. And yet how simple are these problems when compared with that relating to the origin and progress of language!

It is, however, less in tracing the first rudiments of speech, than in some collateral inquiries concerning the genius of different languages, that Condillac's ingenuity appears to advantage. Some of his observations, in particular, on the connection of natural signs with the growth of a systematical prosody, and on the imitative arts of the Greeks and Romans, as distinguished from those of the moderns, are new and curious; and are enlivened with a mixture of historical illustration, and of critical discussion, seldom to be met with among metaphysical writers.

But through all his researches, the radical error may, more or less, be traced, which lies at the bottom of his system;[1] and hence it is, that, with all his skill as a writer, he never elevates the imagination, or touches the heart. That he wrote with the best intentions, we have satisfactory evidence; and yet hardly a philosopher can be named, whose theories have had more influence in misleading the opinions of his contemporaries.[2] In

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[1] A remarkable instance of this occurs in that part of Condillac's *Cours d'Etude,* where he treats of the art of writing: "Vous savez Monseigneur comment les mêmes noms ont été transportés des objets qui tombent sous les sens à ceux qui les échappent. Vous avez remarqué, qu'il y en a qui sont encore en usage dans l'un et l'autre acceptation, et qu'il y en a qui sont devenus les noms propres des choses, dont ils avoient d'abord été les signes figurés.

"Les premiers, tel que le *mouvement* de l'ame, son *penchant,* sa *réflexion,* donnent un corps à des choses qui n'en ont pas. Les seconds, tels que la *pensée,* la *volonté,* le *desir,* ne peignent plus rien, et laissent aux idées abstraites cette spiritualité qui les dérobe aux sens. Mais si le langage doit être l'image de nos pensées, on a perdu beaucoup, lorsqu' oubliant la première signification des mots, on a éffacé jusqu'au traits qu'ils donnoient aux idées. Toutes les langues sont en cela plus ou moins défectueuses, toutes aussi ont des tableaux plus ou moins conservés." (*Cours d'Etude,* Tome II. p. 212. à Parme, 1775.)

Condillac enlarges on this point at considerable length; endeavouring to show, that whenever we lose sight of the analogical origin of a figurative word, we become insensible to one of the chief beauties of language. "In the word *examen,* for example, a Frenchman perceives only the proper name of one of our mental operations. A Roman attached to it the same idea, and received over and above the image of weighing and balancing. The case is the same with the words *ame* and *anima; pensée* and *cogitatio.*"

In this view of the subject, Condillac plainly proceeded on his favourite principle, that all our notions of our mental operations are compounded of sensible images. Whereas the fact is, that the only just notions we can form of the powers of the mind are obtained by abstracting from the qualities and laws of the material world. In proportion, therefore, as the analogical origin of a figurative word disappears, it becomes a fitter instrument of metaphysical thought and reasoning. (See *Philosophical Essays,* Part I. Essay V. Chap. iii.)

[2] A late writer (M. de Bonald), whose philosophical opinions, in general, agree nearly with those of La Harpe, has, however, appreciated very differently, and, in my judgment, much more sagaciously, the merits of Condillac: "Condillac a eu sur l'esprit philosophique du dernier siècle, l'influence que Voltaire à prise sur l'esprit religieux, et J. J. Rousseau sur les opinions politiques. Condillac à mis de la séchéresse et de la minutie dans les esprits; Voltaire du penchant à la raillerie et à la frivolité; Rousseau les à rendus chagrins et mécontens........ Condillac a encore plus faussé l'esprit de la nation, parce que sa doctrine étoit enseignée dans les premières études à des jeunes gens qui n'avoient encore lu ni Rousseau, ni Voltaire, et que la

France, he very early attained to a rank and authority not inferior to those which have been so long and so deservedly assigned to Locke in England; and even in this country, his works have been more generally read and admired, than those of any foreign metaphysician of an equally recent date.

The very general sketches to which I am here obliged to confine myself, do not allow me to take notice of various contributions to metaphysical science, which are to be collected from writers professedly intent upon other subjects. I must not, however, pass over in silence the name of Buffon, who, in the midst of those magnificent views of external nature, which the peculiar character of his eloquence fitted him so admirably to delineate, has frequently indulged himself in ingenious discussions concerning the faculties both of men and of brutes. His subject, indeed, led his attention chiefly to man, considered as an animal; but the peculiarities which the human race exhibit in their physical condition, and the manifest reference which these bear to their superior rank in the creation, unavoidably engaged him in speculations of a higher aim, and of a deeper interest. In prosecuting these, he has been accused (and perhaps with some justice) of ascribing too much to the effects of bodily organization on the intellectual powers; but he leads his reader in so pleasing a manner from matter to mind, that I have no doubt he has attracted the curiosity of many to metaphysical inquiries, who would never otherwise have thought of them. In his theories concerning the nature of the brutes, he has been commonly considered as leaning to the opinion of Descartes; but I cannot help thinking, without any good reason. Some of his ideas on the complicated operations of insects appear to me just and satisfactory; and while they account for the phenomena, without ascribing to the animal any

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manière de raisonner et la direction philosophique de l'esprit s'étendent à tout." (*Recherches Phil.* Tome I. pp. 187, 188.)

The following criticism on the supposed perspicuity of Condillac's style is so just and philosophical, that I cannot refrain from giving it a place here: " Condillac est, ou paroit être, clair et méthodique; mais il faut prendre garde que la clarté des pensées, comme la transparence des objets physiques, peut tenir d'un défaut de profondeur, et que la méthode dans les écrits, qui suppose la patience de l'esprit, n'en prouve pas toujours la justesse; et moins encore la fécondité. Il y a aussi une clarté de style en quelque sorte toute materielle, qui n'est pas incompatible avec l'obscurité dans les idées. Rien de plus facile à entendre que les mots de *sensations transformées* dont Condillac s'est servi, parce que ces mots ne parlent, qu'à l'imagination, qui se figure à volonté des transformations et des changemens. Mais cette transformation, appliquée aux operations de l'esprit, n'est qu'un mot vide de sens; et Condillac lui-même, auroit été bien embarrassé d'en donner une explication satisfaisante. Ce philosophe me paroit plus heureux dans ses apperçus que dans ses demonstrations: La route de la vérité semble quelquefois s'ouvrir devant lui, mais retenu par la circonspection naturelle à un esprit sans chaleur, et intimidé par la faiblesse de son propre systême, il n'ose s'y engager." (*Ibid.* Tome I. pp. 33, 34.)

deep or comprehensive knowledge, are far from degrading him to an insentient and unconscious machine.

In his account of the process by which the use of our external senses (particularly that of sight) is acquired, Buffon has in general followed the principles of Berkeley; and, notwithstanding some important mistakes which have escaped him in his applications of these principles, I do not know that there is anywhere to be found so pleasing or so popular an exposition of the theory of vision. Nothing certainly was ever more finely imagined, than the recital which he puts into the mouth of our first parent, of the gradual steps by which he learned the use of his perceptive organs; and although there are various parts of it which will not bear the test of a rigorous examination, it is impossible to read it without sharing in that admiration, with which we are told the author himself always regarded this favourite effusion of his eloquence.

Nor are these the only instances in which Buffon has discovered the powers of a metaphysician. His thoughts on probabilities, (a subject widely removed from his favourite studies,) afford a proof how strongly some metaphysical questions had laid hold of his curiosity, and what new lights he was qualified to throw on them, if he had allowed them to occupy more of his attention.[1] In his observations too, on the peculiar nature of mathematical evidence, he has struck into a train of the soundest thinking, in which he has been very generally followed by our later logicians.[2] Some particular expressions in the passage I refer to are exceptionable; but his remarks on what he calls *Vérités de Définition* are just and important: nor do I remember any modern writer, of an earlier date, who has touched on the same argument. Plato, indeed, and after him Proclus, had called the definitions of geometry *Hypotheses*; an expression which may be considered as involving the doctrine which Buffon and his successors have more fully unfolded.

What the opinions of Buffon were on those essential questions, which were then in dispute among the French philosophers, his writings do not furnish the means of judging with certainty. In his theory of *Organic Molecules*, and of *Internal Moulds*, he has been accused of entertaining views not very different from those of the ancient atomists; nor would it perhaps be easy to repel the charge, if we were not able to oppose to this wild and unintelligible hypothesis the noble and elevating strain, which in general so peculiarly characterises his descriptions of nature. The eloquence of some of the finest passages in his works has manifestly been inspired by the same sentiment which dictated to one of his

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[1] See his *Essai d'Arithmétique Morale*.

[2] See the First Discourse prefixed to his Natural History, towards the end.

favourite authors the following just and pathetic reflection: "Le spectacle de la nature, si vivant, si animé pour ceux qui reconnoissent un Dieu, est mort aux yeux de l'athée, et dans cette grande harmonie des êtres ou tout parle de Dieu d'une voix si douce, il n'apperçoit qu'un silence eternel."[1]

I have already mentioned the strong bias towards materialism, which the authors of the *Encyclopédie* derived from Condillac's comments upon Locke. These comments they seem to have received entirely upon credit, without ever being at pains to compare them with the original. Had D'Alembert exercised freely his own judgment, no person was more likely to have perceived their complete futility; and, in fact, he has thrown out various observations which strike at their very root. Notwithstanding, however, these occasional glimpses of light, he invariably reverts to the same error, and has once and again repeated it in terms as strong as Condillac or Gassendi.

The author who pushed this account of the origin of our knowledge to the most extraordinary and offensive consequences was Helvetius. His book, *De l'Esprit*, is said to have been composed of materials collected from the conversations of the society in which he habitually lived; and it has accordingly been quoted as an authentic record of the ideas then in fashion among the wits of Paris. The unconnected and desultory composition of the work certainly furnishes some intrinsic evidence of the truth of this anecdote.

According to Helvetius, as all our ideas are derived from the external senses,[2] the

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[1] Rousseau.—In a work by Hérault de Sechelles (entitled *Voyage à Montbar, contenant des details très intéressans sur le caractère, la personne, et les écrits de Buffon*, Paris, 1801), a very different idea of his religious creed is given from that which I have ascribed to him; but, in direct opposition to this statement, we have a letter dictated by Buffon, on his death-bed, to Madame Necker, in return for a present of her husband's book, *On the Importance of Religious Opinions.* The letter (we are told) is in the hand-writing of Buffon's son, who describes his father as then too weak to hold the pen. (*Mélanges extraits des Manuscrits de Madame Necker.* 3 Vols. Paris, 1788.)

The sublime address to the Supreme Being, with which Buffon closes his reflections on the calamities of war, seems to breathe the very soul of Fenelon. "Grand Dieu! dont la seule présence soutient la nature et maintient l'harmonie des loix de l'univers," &c. &c. &c.

[2] In combating the philosophy of Helvetius, La Harpe (whose philosophical opinions seem, on many occasions, to have been not a little influenced by his private partialities and dislikes) exclaims loudly against the same principles to which he had tacitly given his unqualified approbation in speaking of Condillac. On this occasion he is at pains to distinguish between the doctrines of the two writers; asserting that Condillac considered our senses as only the *occasional* causes of our ideas, while Helvetius represented the former as the *productive* causes of the latter. (*Cours de Litterat.* Tome XV. pp. 348, 349.) But that this is by no means reconcileable with the general spirit of Condillac's works (although perhaps some detached expressions may be selected from them admitting of such an interpretation), appears sufficiently from the passages formerly quoted. In addition to these, I beg leave to transcribe the following: "Dans le systême que toutes nos connoisances viennent des sens,

causes of the inferiority of the souls of brutes to those of men, are to be sought for in the difference between them with respect to bodily organization. In illustration of this remark, he reasons as follows:

"1. The feet of all quadrupeds terminate either in horn, as those of the ox and the deer; or in nails, as those of the dog and the wolf; or in claws, as those of the lion and the cat. This peculiar organization of the feet of these animals deprives them not only of the sense of touch, considered as a channel of information with respect to external objects, but also of the dexterity requisite for the practice of the mechanical arts.

"2. The life of animals, in general, being of a shorter duration than that of man, does not permit them to make so many observations, or to acquire so many ideas.

"3. Animals being better armed and better clothed by nature than the human species, have fewer wants, and consequently fewer motives to stimulate or to exercise their invention. If the voracious animals are more cunning than others, it is because hunger, ever inventive, inspires them with the art of stratagems to surprise their prey.

"4. The lower animals compose a society that flies from man, who, by the assistance of weapons made by himself, is become formidable to the strongest amongst them.

"5. Man is the most prolific and versatile animal upon earth. He is born and lives in every climate; while many of the other animals, as the lion, the elephant, and the rhinoceros, are found only in a certain latitude. And the more any species of animals capable of making observations is multiplied, the more ideas and the greater ingenuity is it likely to possess.

"But some may ask (continues Helvetius), why monkeys, whose paws are nearly as dexterous as our hands, do not make a progress equal to that of man? A variety of causes (he observes) conspire to fix them in that state of inferiority in which we find them: 1.

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rien n'est plus aisé que de se faire une notion exacte des idées. Car elles ne sont que des sensations ou des portions extraites de quelque sensation pour être considerées à part; ce qui produit deux sortes d'idées, les sensibles et les abstraites." (*Traité des Systêmes*, Chap. vi.) "Puisque nous avons vu que le souvenir n'est qu'une manière de sentir, c'est une consequence, que les idées intellectuelles ne diffèrent pas essentiellement des sensations mêmes." (*Traité des Sensations*, Chap. viii. § 33.) Is not this precisely the doctrine and even the language of Helvetius?

In the same passage of the *Lycée*, from which the above quotation is taken from La Harpe, there is a sweeping judgment pronounced on the merits of Locke, which may serve as a specimen of the author's competency to decide on metaphysical questions: "Locke à prouvé autant qu'il est possible à l'homme, que l'ame est une substance simple et indivisible, et par conséquent immaterielle. Cependant, il ajoute, qu'il n'oseroit affirmer que Dieu ne puisse douer la matière de pensée. Condillac est de son avis sur le premier article, et le combat sur le second. Je suis entièrement de l'avis de Condillac, et *tous les bons métaphysiciens conviennent que c'est la seule inexactitude qu'on puisse relever dans l'ouvrage de Locke.*" (*Cours de Litterat.* Tome XV. p. 149.)

Men are more multiplied upon the earth. 2. Among the different species of monkeys, there are few whose strength can be compared with that of man, and, accordingly, they form only a fugitive society before the human race. 3. Monkeys being frugivorous, have fewer wants, and, therefore, less invention than man. 4. Their life is shorter. And, finally, the organical structure of their bodies keeping them, like children, in perpetual motion, even after their desires are satisfied, they are not susceptible of lassitude (*ennui*), which ought to be considered (as I shall prove afterwards) as one of the principles to which the human mind owes its improvement.

"By combining (he adds) all these differences between the nature of man and of beast, we may understand why sensibility and memory, though faculties common to man and to the lower animals, are in the latter only sterile qualities."[1]

The foregoing passage is translated literally from a note on one of the first paragraphs of the book *De l'Esprit;* and in the sentence of the text to which the note refers, the author triumphantly asks, "Who can doubt, that if the wrist of a man had been terminated by the hoof of a horse, the species would still have been wandering in the forest?"

Without attempting any examination of this shallow and miserable theory, I shall content myself with observing, that it is not peculiar to the philosophers of modern France. From the *Memorabilia* of Xenophon it appears, that it was current among the sophists of Greece; and the answer given it by Socrates is as philosophical and satisfactory as any thing that could possibly be advanced in the present state of the sciences.

"And canst thou doubt, Aristodemus, if the gods take care of man? Hath not the privilege of an erect form been bestowed on him alone? Other animals they have provided with feet, by which they may be removed from one place to another; but to man they have also given the use of the hand. A tongue hath been bestowed on every other animal; but what animal, except man, hath the power of making his thoughts intelligible to others?

"Nor is it with respect to the body alone that the gods have shown themselves bountiful to man. Who seeth not, that he is as it were a god in the midst of this visible crea-

[1] It is not a little surprising that, in the above enumeration, Helvetius takes no notice of the want of *language* in the lower animals; a faculty without which, the multiplication of individuals could contribute nothing to the improvement of the species. Nor is this want of language in the brutes owing to any defect in the organs of speech; as sufficiently appears from those tribes which are possessed of the power of articulation in no inconsiderable a degree. It plainly indicates, therefore, some defect in those higher principles which are connected with the use of artificial signs.

tion? So far doth he surpass all animals whatever in the endowments of his body and his mind. For if the body of the ox had been joined to the mind of man, the invention of the latter would have been of little avail, while unable to execute his purposes with facility. Nor would the human form have been of more use to the brute, so long as he remained destitute of understanding. But in thee, Aristodemus, hath been joined to a wonderful soul, a body no less wonderful; and sayest thou, after this, the gods take no care of me? What wouldst thou then more to convince thee of their care?"[1]

A very remarkable passage to the same purpose occurs in Galen's treatise, *De Usu Partium*. "But as of all animals man is the wisest, so *hands* are well fitted for the purposes of a wise animal. For it is not because he had hands that he is therefore wiser than the rest, as Anaxagoras alleged; but because he was wiser than the rest that he had therefore hands, as Aristotle has most wisely judged. Neither was it his hands but his reason which instructed man in the arts. The hands are only the organs by which the arts are practised."[2]

The contrast, in point of elevation, between the tone of French philosophy, and that of the best heathen moralists, was long ago remarked by Addison; and of this contrast, it would be difficult to find a better illustration than the passages which have just been quoted.

The disposition of ingenious men to pass suddenly from one extreme to another in matters of controversy, has, in no instance, been more strikingly exemplified than in the opposite theories concerning the nature of the brutes, which successively became fashionable in France during the last century. While the prevailing creed of French materialists leads to the rejection of every theory which professes to discriminate the rational mind from the animal principle of action, it is well known that, but a few years before, the disciples of Descartes allowed no one faculty to belong to man and brutes in common; and even went so far as to consider the latter in the light of mere machines. To this paradox the author was probably led, partly by his anxiety to elude the objection which the faculties of the lower animals have been supposed to present to the doctrine of the immortality of the soul, and partly by the difficulty of reconciling their sufferings with the Divine Goodness.

Absurd as this idea may now appear, none of the tenets of Descartes were once adopted with more implicit faith by some of the profoundest thinkers in Europe. The great Pascal admired it as the finest and most valuable article of the Cartesian system; and of the

[1] Mrs Sarah Fielding's translation.

[2] Galen, *De Us. Part.* l. 1. c. 3.

deep impression it made on the mind of Malebranche, a most decisive proof was exhibited by himself in the presence of Fontenelle. "M. de Fontenelle contoit (says one of his intimate friends[1]) qu'un jour étant allé voir Malebranche aux P. P. de l'Oratoire de la Rue St Honoré, une grosse chienne de la maison, et qui étoit pleine, entra dans la salle ou ils se promenoient, vint caresser le P. Malebranche, et se rouler à ses pieds. Aprés quelques mouvemens inutiles pour la chasser, le philosophe lui donna un grand coup de pied, qui fit jetter à la chienne un cri de douleur, et à M. de Fontenelle un cri de compassion. Eh quoi (lui dit froidement le P. Malebranche) ne sçavez vous pas bien que cela ne se sent point?"

On this point Fontenelle, though a zealous Cartesian, had the good sense to dissent openly from his master, and even to express his approbation of the sarcastic remark of La Motte, *que cette opinion sur les animaux étoit une débauche de raisonnement.* Is not the same expression equally applicable to the opposite theory quoted from Helvetius?[2]

From those representations of human nature which tend to assimilate to each other the faculties of man and of the brutes, the transition to atheism is not very wide. In the present instance, both conclusions seem to be the necessary corollaries of the same fundamental maxim. For if all the sources of our knowledge are to be found in the external senses, how is it possible for the human mind to rise to a conception of the Supreme Being, or to that of any other truth either of natural or of revealed religion?

To this question Gassendi and Condillac, it cannot be doubted, were both able to return an answer, which seemed to themselves abundantly satisfactory. But how few of the multitude are competent to enter into these refined explanations? And how much is it to be dreaded, that the majority will embrace, with the general principle, all the more obvious consequences which to their own gross conceptions it seems necessarily to involve? Something of the same sort may be remarked in the controversy about the freedom of the human will. Among the multitudes whom Leibnitz and Edwards have made converts to the scheme of necessity, how comparatively inconsiderable is the number who have acquiesced in their subtile and ingenious attempts to reconcile this scheme with man's accountableness and moral agency?

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[1] The Abbé Trublet in the *Mercure de Juillet*, 1757. See *Œuvres de Fontenelle*, Tome II. p. 137. Amsterdam, 1764.

[2] In La Fontaine's *Discours à Madame de la Sabliere* (Liv. X. Fable I.), the good sense with which he points out the extravagance of both these extremes is truly admirable. His argument (in spite of the fetters of rhime) is stated, not only with his usual grace, but with singular clearness and precision; and, considering the period when he wrote, reflects much honour on his philosophical sagacity.

Of the prevalence of atheism at Paris, among the higher classes, at the period of which we are now speaking, the *Memoirs* and *Correspondence* of the Baron de Grimm afford the most unquestionable proofs.[1] His friend Diderot seems to have been one of its most zealous abettors; who, it appears from various accounts, contributed to render it fashionable, still more by the extraordinary powers of his conversation, than by the odd combination of eloquence and of obscurity displayed in all his metaphysical productions.[2]

In order, however, to prevent misapprehension of my meaning, it is proper for me to caution my readers against supposing that *all* the eminent French philosophers of this period were of the same school with Grimm and Diderot. On this subject many of our English writers have been misled by taking for granted that to speak lightly of final causes is, of itself, sufficient proof of atheism. That this is a very rash as well as uncharitable conclusion, no other proof is necessary than the manner in which final causes are spoken of by Descartes himself, the great object of whose metaphysical writings plainly was, to establish by demonstration the existence of God. The following vindication of this part of the Cartesian philosophy has been lately offered by a French divine, and it may be ex-

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[1] The *Système de la Nature* (the boldest, if not the ablest, publication of the Parisian atheists appeared in 1770. It bore on the title-page the name of Mirabaud, a respectable but not very eminent writer, who, after long filling the office of perpetual secretary to the French Academy, died at a very advanced age in 1760. (He was chiefly known as the author of very indifferent translations of *Tasso* and *Ariosto*.) It is now, however, universally admitted that Mirabaud had no share whatever in the composition of the *Sytême de la Nature*. It has been ascribed to various authors; nor am I quite certain, that, among those who are most competent to form a judgment upon this point, there is yet a perfect unanimity. In one of the latest works which has reached this country from France (the *Correspondance inédite de Galiani*, 1818), it seems to be assumed by the editors, as an acknowledged fact, that it proceeded from the pen of the Baron d'Holbach. The Abbé Galiani having remarked, in one of his letters to Madame Epinay, that it appeared to him to come from the same hand with the *Christianisme Devoilé* and the *Militaire Philosophe*, the editors remark in a note, " On peut rendre homage à la sagacité de l'Abbé Galiani. *Le Christianisme Devoilé* est en effet le premier ouvrage Philosophique du Baron d'Holbach. C'est en vain que la *Biographie Universelle* nous assure, d'après le temoignage de Voltaire, que cet ouvrage est de Damilaville."

Having mentioned the name of Damilaville, I am tempted to add, that the article relating to him in the *Biographie Universelle*, notwithstanding the incorrectness with which it is charged in the foregoing passage, is not unworthy of the reader's attention, as it contains some very remarkable marginal notes on the *Christianisme Devoilé* copied from Voltaire's own hand-writing.

Since writing the above note, I have seen the Memoirs of M. Suard, by M. Garat (Paris, 1820), in which the biographer, whose authority on this point is perfectly decisive, ascribes with confidence to Baron d'Holbach the *Sytême de la Nature*, and also a work entitled *La Morale et La Legislation Universelle*. (Vol. I. pp. 210, 211.)

According to the same author, the Baron d'Holbach was one of Diderot's proselytes. (*Ibid.* p. 208.) His former creed, it would appear, had been very different.

[2] And yet Diderot, in some of his lucid intervals, seems to have thought and felt very differently. (See Note (BB.)

tended with equal justice to Buffon and many others of Descartes's successors: " Quelques auteurs, et particulièrement Leibnitz, ont critiqué cette partie de la doctrine de Descartes; mais nous la croyons irreprochable, si on veut bien l'entendre, et remarquer que Descartes ne parle que des *Fins totales* de Dieu. Sans doute, le soleil par exemple, et les étoiles, ont été faits pour l'homme, dans ce sens, que Dieu, en les créant, a eu en vue l'utilité de l'homme; et cette utilité a été sa fin. Mais cette utilité a-t-elle été l'unique fin de Dieu? Croit-on qu'en lui attribuant d'autres fins, on affoibliroit la reconnoissance de l'homme, et l'obligation ou il est de louer et de benir Dieu dans toutes ses œuvres? Les auteurs de la vie spirituelle, les plus mystiques même, et les plus accrédités, ne l'ont pas cru." (M. l'Abbé Emery, *Editor of the Thoughts of Descartes upon Religion and Morals*, Paris, 1811, p. 79.)

As to the unqualified charge of atheism, which has been brought by some French ecclesiastics against all of their countrymen that have presumed to differ from the tenets of the Catholic church, it will be admitted, with large allowances, by every candid Presbyterian, when it is recollected that something of the same illiberality formerly existed under the comparatively enlightened establishment of England. In the present times, the following anecdote would appear incredible, if it did not rest on the unquestionable testimony of Dr Jortin: " I heard Dr B. say in a sermon, if any one denies the uninterrupted succession of bishops, I shall not scruple to call him a downright atheist. This, when I was young (Jortin adds), was sound, orthodox, and fashionable doctrine." (*Tracts*, Vol. I. p. 436.)[1]

How far the effects of that false philosophy of which Grimm's correspondence exhibits so dark and so authentic a picture, were connected with the awful revolution which soon after followed, it is not easy to say. That they contributed greatly to blacken its atrocities, as well as to revolt against it the feelings of the whole Christian world, cannot be disputed. The experiment was indeed tremendous, to set loose the passions of all classes of men from the restraints imposed by religious principles; and the result exceeded, if possible, what could have been anticipated in theory. The lesson it has afforded has been dearly purchased; but let us indulge the hope that it will not be thrown away on the generations which are to come.

A prediction, which Bishop Butler hazarded many years before, does honour to his political sagacity, as well as to his knowledge of human nature;—that the spirit of irreligion

[1] See Note (CC.)

would produce, some time or other, political disorders, similar to those which arose from religious fanaticism in the seventeenth century.[1]

Nearly about the time that the *Encyclopédie* was undertaken, another set of philosophers, since known by the name of *Economists*, formed themselves into an association for the purpose of enlightening the public on questions of political economy. The object of their studies seemed widely removed from all abstract discussion; but they had, nevertheless, a metaphysical system of their own, which, if it had been brought forward with less enthusiasm and exaggeration, might have been useful in counteracting the gloomy ideas then so generally prevalent about the order of the universe. The whole of their theory proceeds on the supposition that the arrangements of nature are wise and benevolent, and that it is the business of the legislator to study and co-operate with her plans in all his own regulations. With this principle, another was combined, that of the indefinite improvement of which the human mind and character are susceptible; an improvement which was represented as a natural and necessary consequence of wise laws; and which was pointed out to legislators as the most important advantage to be gained from their institutions.

These speculations, whatever opinion may be formed of their solidity, are certainly as remote as possible from any tendency to atheism, and still less do they partake of the spirit of that philosophy which would level man with the brute creation. With their practical tendency in a *political* view we are not at present concerned; but it would be an unpardonable omission, after what has been just said of the metaphysical theories of the same period, not to mention the abstract principles involved in the economical system, as a remarkable exception to the general observation. It may be questioned, too, if the authors of this system, by incorporating their ethical views with their political disquisitions,

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[1] "Is there no danger that all this may raise somewhat like that levelling spirit, upon atheistical principles, which, in the last age, prevailed upon enthusiastic ones? Not to speak of the possibility, that different sorts of people may unite in it upon these contrary principles." (*Sermon preached before the House of Lords*, January 30, 1741.)

As the fatal effects of both these extremes have, in the course of the two last centuries, been exemplified on so gigantic a scale in the two most civilized countries of Europe, it is to be hoped that mankind may in future derive some salutary admonitions from the experience of their predecessors. In the meantime, from that disposition common both to the higher and lower orders to pass suddenly from one extreme to another, it is at least possible that the strong reaction produced by the spirit of impiety during the French Revolution may, in the first instance, impel the multitude to something approaching to the puritanical fanaticism and frenzy of the Cromwellian Commonwealth.

did not take a more effectual step towards discountenancing the opinions to which they were opposed, than if they had attacked them in the way of direct argument.[1]

On the metaphysical theories which issued from the French press during the latter half of the last century, I do not think it necessary for me to enlarge, after what I have so fully stated in some of my former publications. To enter into details with respect to particular works would be superfluous, as the remarks made upon any one of them are nearly applicable to them all. The excellent writings of M. Prevost, and of M. Degerando, will, it is to be hoped, gradually introduce into France a sounder taste in this branch of philosophy.[2] At present, so far as I am acquainted with the state of what is called *Idéologie* in that country, it does not appear to me to furnish much matter either for the instruction or amusement of my readers.

The works of Rousseau have, in general, too slight a connection with metaphysical science, to come under review in this part of my discourse. But to his *Emile*, which has been regarded as a supplement to Locke's *Treatise on Education*, some attention is justly due, on account of various original and sound suggestions on the management of the infant mind, which, among many extravagancies, savouring strongly both of intellectual and moral insanity, may be gathered by a sober and discriminating inquirer. The estimate of the merits of this work, formed by Mr Gray, appears to me so just and impartial, that I shall adopt it here without a comment.

"I doubt" (says he, in a letter to a friend) "you have not yet read Rousseau's *Emile*. Every body that has children should read it more than once; for though it abounds with his usual glorious absurdity, though his general scheme of education be an impracticable

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[1] For some other observations on the Ethical principles assumed in the Economical system, see *Elements of the Philosophy of the Human Mind*, Vol. II. Chap. iv. Section 6, § 1, towards the end.

[2] Some symptoms of such a reformation are admitted already to exist, by an author decidedly hostile to all philosophical systems. "Bacon, Locke, Condillac, cherchoient dans nos sens l'origine de nos idées; Helvetius y a trouvé nos idées elles-mêmes. *Juger*, selon ce philosophe, *n'est autre chose que sentir*.* Aujourd'hui les bons esprits, éclairés par les événemens sur la secrete tendance de toutes ces opinions, les ont soumises à un examen plus sevère. La *transformation* des sensations en idées ne paroit plus qu'un mot vide sens. On trouve que *l'homme statue* ressemble un peu trop à *l'homme machine*, et Condillac est modifié ou même combattu sur quelques points, par tous ceux qui s'en servent encore dans l'enseignement philosophique. (*Recherches Philosophiques, &c.* par M. de Bonald, Tome I. pp. 34, 35.)

* I was somewhat surprised, in looking over very lately the *Principia* of Descartes, to find (what had formerly escaped me), that the mode of speaking objected to in the above paragraph may plead in its favour the authority of that philosopher: "Cogitationis nomine, intelligo illa omnia, quæ nobis consciis in nobis fiunt, quatenus eorum in nobis conscientia est: Atque ita non modo intelligere, velle, imaginari, sed etiam sentire, idem est hic quod cogitare." (*Princ. Phil.* p. 2.) Dr Reid, too, has said that "the sensation of colour is a sort of thought" (*Inquiry*, Chap. vi. § 4); but no names, how great soever, can sanction so gross an abuse of language.

After all, there is some difference between saying, that sensation is a sort of thought, and that thought is a sort of sensation.

chimera, yet there are a thousand lights struck out, a thousand important truths better expressed than ever they were before, that may be of service to the wisest men. Particularly, I think he has observed children with more attention, knows their meaning, and the working of their little passions, better than any other writer. As to his religious discussions, which have alarmed the world, and engaged their thoughts more than any other parts of his book, I set them all at nought, and wish they had been omitted." (Gray's *Works by Mason*, Letter 49.)

The most valuable additions made by French writers to the Philosophy of the Human Mind are to be found, not in their systematical treatises on metaphysics, but in those more popular compositions, which, professing to paint the prevailing manners of the times, touch occasionally on the varieties of intellectual character. In this most interesting and important study, which has been hitherto almost entirely neglected in Great Britain,[1] France must be allowed not only to have led the way, but to remain still unrivalled. It would be endless to enumerate names; but I must not pass over those of Vauvenargues[2]

[1] Many precious hints connected with it may, however, be collected from the writings of Lord Bacon, and a few from those of Mr Locke. It does not seem to have engaged the curiosity of Mr Hume in so great a degree as might have been expected from his habits of observation, and extensive intercourse with the world. The objects of Dr Reid's inquiries led him into a totally different track.

Among German writers, Leibnitz has occasionally glanced with a penetrating eye at the varieties of genius; and it were to be wished that he had done so more frequently. How far his example has been followed by his countrymen in later times, I am unable to judge, from my ignorance of their language.

A work expressly on this subject was published by a Spanish physician (Huarte) in the seventeenth century. A French translation of it, printed at Amsterdam in 1672, is now lying before me. It is entitled, *Examen des Esprits pour les Sciences. Ou se montrent les differences des Esprits, qui se trouvent parmy les hommes et a quel genre de Science un chacun est propre en particulier.* The execution of this work certainly falls far short of the expectations raised by the title; but (allowances being made for the period when it was written) it is by no means destitute of merit, nor unworthy of the attention of those who may speculate on the subject of Education. For some particulars about its contents, and also about the author, see Bayle's *Dictionary*, Art. *Huarte*; and *The Spectator*, No. 30.

[2] The Marquis de Vauvenargues, author of a small volume, entitled *Introduction à la Connoissance de l'Esprit Humain.* He entered into the army at the age of eighteen, and continued to serve for nine years; when, having lost his health irrecoverably, in consequence of the fatigues he underwent in the memorable retreat from Prague, in December 1742, he resolved to quit his profession, in the hope of obtaining some diplomatic employment better suited to his broken constitution. Soon after he was attacked by the small-pox, which unfortunately turned out of so malignant a kind, as to disfigure his countenance, and deprive him almost totally of sight. He died in 1747, at the age of thirty-two. The small volume above mentioned was published the year before his death. It bears everywhere the marks of a powerful, original, and elevated mind; and the imperfect education which the author appears to have received gives it an additional charm, as the genuine result of his own unsophisticated reflections.

Marmontel has given a most interesting picture of his social character: « En le lisant, je crois encore l'entendre, et je ne sais si sa conversation n'avait pas même quelque chose de plus animé, de plus délicat

and Duclos.[1] Nor can I forbear to remark, in justice to an author whom I have already very freely censured, that a variety of acute and refined observations on the different modifications of genius may be collected from the writings of Helvetius. The soundness of some of his distinctions may perhaps be questioned; but even his attempts at classification may serve as useful guides to future observers, and may supply them with a convenient nomeclature, to which it is not always easy to find corresponding terms in other languages. As examples of this it is sufficient to mention the following phrases: *Esprit juste, Esprit borné, Esprit étendu, Esprit fin, Esprit délié, Esprit de lumière.* The peculiar richness of the French tongue in such appropriate expressions (a circumstance, by the way, which not unfrequently leads foreigners to overrate the depth of a talkative Frenchman) is itself a proof of the degree of attention which the ideas they are meant to convey have attracted in that country among the higher and more cultivated classes.

The influence, however, of the philosophical spirit on the general habits of thinking among men of letters in France, was in no instance displayed to greater advantage, than in the numerous examples of *theoretical* or *conjectural* history, which appeared about the middle of last century. I have already mentioned the attempts of Condillac and others, to trace upon this plan the first steps of the human mind in the invention of language. The same sort of speculation has been applied with greater success to the mechanical and other necessary arts of civilized life; and still more ingeniously and happily to the different branches of pure and mixed mathematics. To a philosophical mind, no study certainly can be more delightful than this species of history; but as an organ of instruction, I am not disposed to estimate its practical utility so highly as D'Alembert. It does

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que ses divins ecrits." And, on a different occasion, he speaks of him thus: " Doux, sensible, compatissant, il tenait nos âmes dans ses mains. Une sérénité inaltérable dérobait ses douleurs aux yeux de l'amitié. Pour soutenir l'adversite, on n avoit besoin que de son exemple; et témoin de l'egalité de son âme, on n'osait être malheureux avec lui."

If the space allotted to him in this note should be thought to exceed what is due to his literary eminence, the singular circumstances of his short and unfortunate life, and the deep impression which his virtues, as well as his talents, appear to have left on the minds of all who knew him, will, I trust, be a sufficient apology for my wish to add something to the celebrity of a name, hitherto, I believe, very little known in this country.

[1] The work of Duclos, here referred to, has for its title, *Considerations sur les Moeurs de ce Siècle.* Gibbon's opinion of this book is, I think, not beyond its merits: " L'ouvrage en géneral est bon. Quelques chapitres (le rapport de l'esprit et du caractère) me paroissent excellent." *(Extrait du Journal.)*

I have said nothing of La Rochefoucauld and La Bruyère, as their attention was chiefly confined to manners, and to moral qualities. Yet many of their remarks show, that they had not wholly overlooked the diversities among men in point of intellect. An observer of sagacity equal to their's might, I should think, find a rich field of study in this part of human nature, as well as in the other.

not seem to me at all adapted to interest the curiosity of novices; nor is it so well calculated to engage the attention of those who wish to enlarge their scientific knowledge, as of persons accustomed to reflect on the phenomena and laws of the intellectual world.

Of the application of theoretical history, to account for the diversities of laws and modes of government among men, I shall have occasion afterwards to speak. At present I shall only remark the common relation in which all such researches stand to the Philosophy of the Human Mind, and their common tendency to expand and to liberalize the views of those who are occupied in the more confined pursuits of the subordinate sciences.

After what has been already said of the general tone of French philosophy, it will not appear surprising, that a system so mystical and spiritual as that of Leibnitz never struck its roots deeply in that country. A masterly outline of its principles was published by Madame du Chatelet, at a period of her life when she was an enthusiastic admirer of the author; and a work on such a subject, composed by a lady of her rank and genius, could not fail to produce at first a very strong sensation at Paris; but not long after she herself abandoned the German philosophy, and became a zealous partizan of the Newtonian school. She even translated into French, and enriched with a commentary, the *Principia* of Newton; and by thus renouncing her first faith, contributed more to discredit it, than she had previously done to bring it into fashion. Since that time, Leibnitz has had few, if any, disciples in France, although some of his peculiar tenets have occasionally found advocates there, among those who have rejected the great and leading doctrines, by which his system is more peculiarly characterized. His opinions and reasonings in particular, on the necessary concatenation of all events, both physical and moral (which accorded but too well with the philosophy professed by Grimm and Diderot), have been long incorporated with the doctrines of the French materialists, and they have been lately adopted and sanctioned, in all their extent, by a living author, the unrivalled splendour of whose mathematical genius may be justly suspected, in the case of some of his admirers, to throw a false lustre on the dark shades of his philosophical creed.[1]

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[1] "Les événemens actuels ont avec les précédens une liaison fondée sur le principe évident, qu'une chose ne peut pas commencer, d'être, sans une cause qui la produise. Cet axiome, connu sous le nom de *principe de la raison suffisante*, s'étend aux actions même que l'on juge indifférentes. La volonté la plus libre ne peut, sans un motif déterminant, leur donner naissance; car si, toutes les circonstances de deux positions étant exactement semblables, elle agissoit dans l'une et s'abstenoit d'agir dans l'autre, son choix seriot un effet sans cause;* elle seroit alors, dit Leibnitz, le *hazard aveugle* des Epicuriens. L'opinion contraire est une illusion de l'esprit qui per-

* The impropriety of this language was long ago pointed out by Mr Hume. "They are still more frivolous, who say, that every effect must have a cause, because it is implied in the very idea of effect. Every effect naturally presupposes a cause; effect being a relative term, of which cause is the co-relative. The true state of the question is, whether every object, which begins to exist, must owe its existence to a cause." (*Treatise of Human Nature*, Vol. I. p. 147.)

Notwithstanding, however, this important and unfortunate coincidence, no two systems can well be imagined more strongly contrasted on the whole, than the lofty metaphysics of Leibnitz, and that degrading theory concerning the origin of our ideas, which has been fashionable in France since the time of Condillac. In proof of this, I have only to refer to the account of both, which has been already given.

The same contrast, it would appear, still continues to exist between the favourite doctrines of the German and of the French schools. " In the French empiricism" (says a most impartial, as well as competent judge, M. Ancillon), " the faculty of feeling, and the faculty of knowing, are one and the same. In the new philosophy of Germany, there is no faculty of knowing, but reason. In the former, taking our departure from individuals, we rise by degrees to ideas, to general notions, to principles. In the latter, be-

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dant de vue les raisons fugitives du choix de la volonté dans les choses indifférentes, se persuade qu'elle s'est déterminée d'elle même et sans motifs.

" Nous devons donc envisager l'état présent de l'univers comme l'effet de son état antérieure et comme la cause de celui qui va suivre. Une intelligence qui pour un instant donné connoitroit toutes les forces dont la nature est animée, et la situation respective des êtres qui la composent, si d'ailleurs elle étoit assez vaste pour soumettre ces données à l'analyse, embrasseroit dans la même formule, les mouvemens des plus grands corps de l'univers et ceux du plus léger atôme. Rien nes eroit incertain pour elle, et l'avenir comme le passé, seroit présent à ses yeux." (*Essai Philosophique sur les Probabilités*, par Laplace.)

Is not this the very spirit of the *Theodicæa* of Leibnitz, and, when combined with the other reasonings in the *Essay on Probabilities*, the very essence of Spinozism?

This, indeed, is studiously kept by the author out of the reader's view; and hence the facility with which some of his propositions have been admitted by many of his *mathematical* disciples, who, it is highly probable, were not aware of the consequences which they necessarily involve.

I cannot conclude this note without recurring to an observation ascribed in the above quotation from Laplace to Leibnitz, " that the *blind chance* of the Epicureans involves the supposition of an effect taking place without a cause." This, I apprehend, is a very incorrect statement of the philosophy taught by Lucretius, which nowhere gives the slightest countenance to such a supposition. The distinguishing tenet of this sect was, that the order of the universe does not imply the existence of *intelligent* causes; but may be accounted for by the active powers belonging to the atoms of matter; which active powers, being exerted through an indefinitely long period of time, *might* produce, nay, *must* have produced, exactly such a combination of things, as that with which we are surrounded. This, it is evident, does not call in question the necessity of a cause to produce every effect, but, on the contrary, virtually assumes the truth of that axiom. It only excludes from these causes the attribute of intelligence. It is in the same way when I apply the words blind chance (*hazard aveugle*) to the throw of a die, I do not mean to deny that I am ultimately the cause of the particular event that is to take place; but only to intimate that I do not here act as a *designing* cause, in consequence of my ignorance of the various accidents to which the die is subjected, while shaken in the box. If I am not mistaken, this *Epicurean Theory* approaches very nearly to the scheme, which it is the main object of the *Essay on Probabilities* to inculcate; and, therefore, it was not quite fair in Laplace to object to the supposition of man's free agency, as favouring those principles which he himself was labouring indirectly to insinuate.

From a passage in Plato's *Sophist*, it is very justly inferred by Mr Gray, that, according to the *common* opinion then entertained, " the creation of things was the work of blind unintelligent matter; whereas the con-

ginning with what is most general, or rather with what is universal, we descend to individual existences, and to particular cases. In the one, what we see, what we touch, what we feel, are the only realities. In the other nothing is real, but what is invisible and purely intellectual."

"Both these systems (continues M. Ancillon) result from the exaggeration of a sound principle. They are both true and both false in part; true in what they admit, false in what they reject. All our knowledge begins, or appears to begin, in sensation; but it does not follow from this that it is all derived from sensation, or that sensation constitutes its whole amount. The proper and innate activity of the mind has a large share in the origin of our *representations*, our sentiments, our ideas. Reason involves principles which she does not borrow from without, which she owes only to herself, which the impressions of the senses call forth from their obscurity, but which, far from owing their origin to sensations, serve to appreciate them, to judge of them, to employ them as instruments. It would be rash, however, to conclude from hence, that there is no certainty but in reason, that reason alone can seize the mystery of existences, and the intimate nature of beings, and that experience is nothing but a vain appearance, destitute of every species of reality." [1]

With this short and comprehensive estimate of the new German philosophy, pronounced by one of the most distinguished members of the Berlin Academy, I might perhaps be pardoned for dismissing a subject, with which I have, in some of my former publications, acknowledged myself (from my total ignorance of the German language) to be very imperfectly acquainted; but the impression which it produced for a few years in England

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trary was the result of philosophical reflection and disquisition believed by a few people only." (*Gray's Works* by Matthias, Vol. II. p. 414.) On the same subject, see Smith's *Posthumous Essays*, p. 106.

[1] *Mélanges de Litterature et de Philosophie*, par F. Ancillon, Préface. (à Paris, 1809.) The intimacy of M. Ancillon's literary connections both with France and with Germany entitle his opinions on the respective merits of their philosophical systems to peculiar weight. If he anywhere discovers a partiality for either, the modest account which he gives of himself would lead us to expect his leaning to be in favour of his countrymen. "Placé entre la France et l'Allemagne, appartenant à la première par la langue dans laquelle je hasarde d'écrire, à la seconde par ma naissance, mes études, mes principes, mes affections, et j'ose le dire, par la couleur de ma pensée, je desirerois pouvoir servir de médiateur littéraire, ou d'interprète philosophique entre les deux nations."

In translating from M. Ancillon, the passage quoted in the text, I have adhered as closely as possible to the words of the original; although I cannot help imagining that I could have rendered it still more intelligible to the English reader by laying aside some of the peculiarities of his German phraseology. My chief reason for retaining these, was to add weight to the strictures which a critic, so deeply tinctured with the German habits of thinking and of writing, has offered, on the most prominent faults of the systems in which he had been educated.

(more particularly while our intercourse with the continent was interrupted), makes it proper for me to bestow on it a little more notice in this Dissertation, than I should otherwise have judged necessary or useful.

SECTION VII.

Kant and other Metaphysicians of the New German School.[1]

THE long reign of the Leibnitzian Philosophy in Germany was owing, in no inconsiderable degree, to the zeal and ability with which it was taught in that part of Europe, for nearly half a century, by his disciple Wolfius,[2] a man of little genius, originality, or taste, but whose extensive and various learning, seconded by a methodical head,[3] and by an

[1] My ignorance of German would have prevented me from saying anything of the philosophy of Kant, if the extraordinary pretensions with which it was at first brought forward in this island, contrasted with the total oblivion into which it soon after very suddenly fell, had not seemed to demand some attention to so wonderful a phenomenon in the literary history of the eighteenth century. My readers will perceive that I have taken some pains to atone for my inability to read Kant's works in the original, not only by availing myself of the Latin version of Born, but by consulting various comments on them which have appeared in the English, French, and Latin languages. As commentators, however, and even translators, are not always to be trusted to as unexceptionable interpreters of their authors' opinions, my chief reliance has been placed on one of Kant's own compositions in Latin; his Dissertation *De Mundi Sensibilis atque Intelligibilis Forma et Principiis,* which he printed as the subject of a public disputation, when he was candidate for a Professorship in the University of Kœnigsberg. It is far from being improbable, after all, that I may, in some instances, have misapprehended his meaning, but I hope I shall not be accused of wilfully misrepresenting it. Where my remarks are borrowed from other writers, I have been careful in referring to my authorities, that my reader may judge for himself of the fidelity of my statements. If no other purpose, therefore, should be answered by this part of my work, it may at least be of use by calling forth some person properly qualified to correct any mistakes into which I may involuntarily have fallen; and in the meantime, may serve to direct those who are strangers to German literature, to some of the comments on this philosophy which have appeared in languages more generally understood in this country.

[2] Born 1679. Died 1754.

[3] The display of method, however, so conspicuous in all the works of Wolfius, will often be found to amount to little more than an awkward affectation of the phraseology and forms of mathematics, in sciences where they contribute nothing to the clearness of our ideas, or the correctness of our reasonings. This affectation, which seems to have been well adapted to the taste of Germany at the time when he wrote, is now one of the chief causes of the neglect into which his writings have fallen. Some of them may be still usefully consulted as dictionaries, but to read them is impossible. They amount to about forty quarto volumes, twenty-three of which are in Latin, the rest in German.

incredible industry and perseverance, seem to have been peculiarly fitted to command the admiration of his countrymen. Wolfius, indeed, did not profess to follow implicitly the opinions of his master, and, on some points, laid claim to peculiar ideas of his own; but the spirit of his philosophy is essentially the same with that of Leibnitz,[1] and the particulars in which he dissented from him are too trifling to deserve any notice in the history of literature.[2]

The high reputation so long maintained by Wolfius in Germany suggested, at different times, to the book-makers at Paris, the idea of introducing into France the philosophy which he taught. Hence a number of French abridgments of his logical and metaphysical writings. But an attempt, which had failed in the hands of Madame du Chatelet, was not likely to succeed with the admirers and abridgers of Wolfius.[3]

In his own country the reputation of Wolfius is not yet at an end. In the preface to Kant's *Critique of Pure Reason*, he is called "Summus omnium dogmaticorum Philosophus." Kantii *Opera ad Philosophiam Criticam*, Vol. I. Præf. Auctoris Posterior, p. xxxvi. Latine Vertit. Fred. Born. Lipsiæ, 1796.) And by one of Kant's best commentators, his name is advantageously contrasted with that of David Hume: "Est autem scientifica methodus aut dogmatica, aut sceptica. Primi generis autorem celeberrimum Wolfium, alterius Davidem Humium nominasse sat est." (*Expositio Philos. Criticæ.* Autore Conrado Friderico a Schmidt-Phiseldek. Hafniæ, 1796.)

[1] On the great question of Free Will, Wolfius adopted implicitly the principles of the *Theodicæa;* considering man merely in the light of a *machine*; but (with the author of that work) dignifying this machine by the epithet *spiritual.* This language, which is still very prevalent among German philosophers, may be regarded as a relic of the doctrines of Leibnitz and of Wolfius; and affords an additional proof of the difficulty of eradicating errors sanctioned by illustrious and popular names.

When the system of Pre established Harmony was first introduced by Wolfius into the University of Halle it excited an alarm which had very nearly been attended with fatal consequences to the professor. The following anecdote on the subject is told by Euler: "Lorsque du temps du feu Roi de Prusse, M. Wolf enseignoit à Halle le systême de l'Harmonie Pré-établie, le Roi s'informa de cette doctrine, qui faisoit grand bruit alors; et un courtisan repondit à sa Majesté, que tous les soldats, selòn cette doctrine, n'étoient que des machines; que quand il en désertoit c'étoit une suite nécessaire de leur structure, et qu'on avoit tort par consequent de les punir, comme on l'auroit si on punissoit une machine pour avoir produit tel ou tel mouvement. Le Roi se facha si fort sur ce rapport, qu'il donna ordre de chasser M. Wolf de Halle sous peine d'être pendu s'il s'y trouvoit au bout de 24 heurs. Le philosophe se refugia alors à Marbourg, où je lui ai parlé peu de temps après." (*Lettres à une Princesse d'Allemagne,* Lettre 84me.) We are informed by Condorcet, that some reparation was afterwards made for this injustice by Frederic the Great. "Le Roi de Prusse, qui ne croit pas pourtant à l'Harmonie Pré-etablie, s'est empressé de rendre justice à Wolf dès le premier jour de son regne."

[2] Among other novelties affected by Wolfius, was a new modification of the Theory of the Monads. A slight outline of it, but quite sufficient, I should suppose, to gratify the curiosity of most readers, may be found in Euler's *Letter to a German Princess.*

[3] To what was before remarked, of the opposition in matters of philosophy between the taste of the French and that of the Germans, I shall here add a short passage from an author intimately acquainted with the literature of both nations.

From the time of Wolfius till the philosophy of Kant began to attract general notice, I know of no German metaphysician whose speculations seem to have acquired much celebrity in the learned world.[1] Lambert[2] is perhaps the most illustrious name which occurs during this interval. As a mathematician and natural philosopher, his great merits are universally known and acknowledged, but the language in which his metaphysical and logical works were written, has confined their reputation within a comparatively narrow circle. I am sorry that I cannot speak of these from my own knowledge; but I have heard them mentioned in terms of the highest praise, by some very competent judges, to whose testimony I am disposed to give the greater credit, from the singular vein of originality which runs through all his mathematical and physical publications.[3]

"L'ecole Allemande reconnoit Leibnitz pour chef. Son fameux disciple Wolf régna dans les universités pendant près d'un demi siècle avec une autorité non contestée. On connoit en France cette philosophie par un grand nombre d'abregés dont quelque-uns sont faits par des auteurs qui seuls auroient suffi pour lui donner de la célébrité.

"Malgré l'appui de tous ces noms, *jamais en France cette philosophie ne s'est soutenue même quelques instans.* La profondeur apparente des idées, l'air d'ensemble et de systéme, n'ont jamais pu y suppléer à ce qui a paru lui manquer pour en faire une doctrine solide et digne d'être accueillie. Outre quelque défaut de clarté, qui probablement en a écarté des esprits pour qui cette qualité de style et de la pensée est devenue un heureux besoin, la forme sous laquelle elle se présente a rebuté bien des lecteurs. Quoi qu'aient pu faire les interprétes, il a toujours percé quelque chose de l'appareil incommode qui l'entoure à son origine. Condillac tourne plus d'une fois en ridicule ces formes et ce jargon scientifique, et il s'applique à montrer qu'ils ne sont pas plus propres à satisfaire la raison que le goût. *Il est au moins certain, que le lecteur Français les repousse par instinct, et qu'il y trouve un obstacle très difficile à surmonter.*" (*Reflexions sur les Œuvres Posthumes d'Adam Smith*, par M. Prevost de Genève. à Paris, 1794.)

[1] Madame de Staël mentions Lessing, Hemsterhuis, and Jacobi, as precursors of Kant in his philosophical career. She adds, however, that they had no school, since none of them attempted to found any system; but they began the war against the doctrines of the Materialists. (*Allemagne*, Tome III. p. 98.) I am not acquainted with the metaphysical works of any of the three. Those of Hemsterhuis, who wrote wholly in French, were, I understand, first published in a collected form at Paris, in 1792. He was son of the celebrated Greek scholar and critic, Tiberius Hemsterhusius, Professor of Latin Literature at Leyden.

[2] Born at Mulhausen in Alsace in 1728. Died at Berlin in 1777.

[3] The following particulars, with respect to Lambert's literary history, are extracted from a *Memoir* annexed by M. Prevost to his translation of Mr Smith's *Posthumous Works*: "Cet ingenieux et puissant Lambert, dont les mathématiques, qui lui doivent beaucoup, ne purent épuiser les forces, et qui ne toucha aucun sujet de physique ou de philosophie rationelle, sans le couvrir de lumière. Ses *lettres cosmologiques*, qu'il écrivit par forme de délassement, sont pleines d'idées sublimes, entées sur la philosophie la plus saine et la plus savante tout-à-la fois. Il avoit aussi dressé sous le titre *d'Architectonique* un tableau des principes sur lesquels se fondent les connoissances humaines. Cet ouvrage au jugement des hommes les plus versés dans l'étude de leur langue, n'est pas exempt d'obscurité. Elle peut tenir en partie à la nature du sujet. Il est à regretter que sa logique, intitulé *Organon*, ne soit traduite ni en Latin, ni en Français, ni je pense en aucune langue. Un extrait bien fait de cet ouvrage, duquel on ecarteroit ce qui répugne au goût national, exciteroit l'attention des philosophes, et la por-

The *Critique of Pure Reason* (the most celebrated of Kant's metaphysical works) appeared in 1781.[1] The idea annexed to the title by the author, is thus explained by himself: "Criticam rationis puræ non dico censuram librorum et Systematum, sed facultatis rationalis in universum, respectu cognitionum omnium, ad quas, ab omni experientia libera, possit anniti, proinde dijudicationem possibilitatis aut impossibilitatis metaphysices in genere, constitutionemque tum fontium, tum ambitus atque compagis tum vero terminorum illius, sed cuncta haec ex principiis." (Kantii, *Opera ad Philosophiam Criticam*, Vol. I. Præfatio Auctoris Prior. pp. xi. xii.) To render this somewhat more intelligible, I shall subjoin the comment of one of his intimate friends,[2] whose work, we are informed by Dr Willich, had received the sanction of Kant himself. "The aim of Kant's *Critique* is no less than to lead Reason to the true knowledge of itself; to examine the titles upon which it founds the supposed possession of its metaphysical knowledge; and by means of this examination to mark the true limits, beyond which it cannot venture to speculate, without wandering into the empty region of pure fancy." The same author adds, "The whole *Critique of Pure Reason* is established upon this principle, *that there is a free reason, independent of all experience and sensation.*"

When the *Critique of Pure Reason* first came out, it does not seem to have attracted much notice,[3] but such has been its subsequent success, that it may be regarded (according

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teroit sur une multitude d'objéts qu'ils se sont accoutumés à regarder avec indifférence." (Prevost, Tome II. pp. 267, 268.)

In the article *Lambert*, inserted in the twenty-third volume of the *Biographie Universelle* (Paris, 1819), the following account is given of Lambert's logic · "Wolf, d'après quelques indications de Leibnitz, avoit retiré de l'oubli la syllogistique d'Aristote, science que les scholastiques avoient tellement avilie que ni Bacon ni Locke n'avoient osé lui accorder un regard d'intéret. Il étoit reservé à Lambert de la montrer sous le plus beau jour et dans la plus riche parure. C'est ce qu'il a fait dans son *Novum Organon*, ouvrage qui est un des principaux titres de gloire de son auteur." From the writer of this article (M. Servois) we farther learn, that the *Novum Organon* of Lambert was translated into Latin from the German original by a person of the name of Pfleiderer, and that this translation was in the hands of an English nobleman (the late Earl of Stanhope) as lately as 1782. I quote the words of M. Servois, in the hope that they may attract some attention to the manuscript, if it be still in existence. The publication of it would certainly be a most acceptable present to the learned world. "D'après le conseil de Le Sage de Geneve, l'ouvrage fut traduit en Latin par Pfleiderer, aux frais d'un savant Italien, cette traduction passa, on ne sait comment, entre les mains de Milord Mahon qui la possedoit encore en 1782; on ignore quel est son sort ulterieur."

[1] Kant was born at Kœnigsberg, in Prussia, in 1724. He died in 1804.

[2] Mr John Schulze, an eminent divine at Kœnigsberg, author of the *Synopsis of the Critical Philosophy*, translated by Dr Willich, and inserted in his *Elementary View of Kant's Works*. (See pp. 42, 43.)

[3] "Il se passa quelque tems après la première publication de la *Critique de la Pure Raison*, sans qu'on fit beaucoup d'attention à ce livre, et sans que la plupart de philosophes, passionés pour l'éclectisme

to Madame de Staël)[1] "as having given the impulse to all that has been since done in Germany, both in literature and in philosophy." (*Allemagne*, Vol. III. pp. 68, 69.)

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soupçonassent seulement la grande révolution que cet ouvrage et les productions suivantes de son auteur devoient opérer dans la science." (Buhle, *Hist. de la Phil. Mod.* Tom. VI. p. 573. Paris, 1816.)

As early, however, as the year 1783, the philosophy of Kant appears to have been adopted in *some* of the German schools. The ingenious M. Trembley, in a memoir then read before the Academy of Berlin, thus speaks of it: "La philosophie de Kant, qui *à la honte de l'esprit humain*, paroit avoir acquis tant de faveur dans certaines écoles." (*Essai sur les Préjugés.* Reprinted at Neufchatel in 1790.)

We are farther told by Buhle, that the attention of the public to Kant's *Critique of Pure Reason* was first attracted by an excellent analysis of the work, which appeared in the *General Gazette of Literature*, and by the *Letters on Kant's Philosophy*, which Reinhold inserted in the *German Mercury*. (Buhle, Tom. VI. p. 573.) Of this last philosopher, who appears, in the first instance, to have entered with enthusiasm into Kant's views, and who afterwards contributed much to open the eyes of his countrymen to the radical defects of his system, I shall have occasion to speak hereafter. Degerando, as well as Buhle, bestows high praise not only on his clearness, but on his eloquence, as a writer in his own language. "Il a traduit les oracles Kantiens dans une langue élégante, harmonieuse, et pure * * * Il a su exprimer avec un langage éloquent, des idées jusqu'alors inintelligibles," &c. (*Histoire Comparée*, &c. Tom. II. p. 271.) That this praise is not undeserved I am very ready to believe, having lately had an opportunity (through the kindness of my learned and revered friend Dr Parr) of reading in the Latin version of Fredericus Gottlob Born, Reinhold's principal work, entitled *Periculum Novæ Theoriæ Facultatis Repræsentativæ Humanæ.* In point of perspicuity, he appears to me to be greatly superior to Kant; and of this I conceive myself to be not altogether incompetent to judge, as the Latin versions of both authors are by the same hand.

[1] The following quotation, from the advertisement prefixed to Madame de Stael's posthumous work (*Considérations sur la Révolution Française*), will at once account to my readers for the confidence with which I appeal to her historical statements on the subject of German philosophy. Her own knowledge of the language was probably not so critically exact, as to enable her to enter into the more refined details of the different systems which she has described; but her extraordinary penetration, joined to the opportunities she enjoyed of conversing with all that was then most illustrious in Germany, qualified her in an eminent degree to seize and to delineate their great outlines. And if, in executing this task, any considerable mistakes could have been supposed to escape her, we may be fully assured, that the very accomplished person, to whose revision we learn that her literary labours at this period of her life were submitted, would prevent them from ever meeting the public eye. I except, of course, those mistakes into which she was betrayed by her admiration of the German school. Of some of the most important of these, I shall take notice as I proceed; a task which I feel incumbent on me, as it is through the medium of her book that the great majority of English readers have acquired all their knowledge of the new German philosophy, and as her name and talents have given it a temporary consequence in this country which it could not otherwise have acquired.

"Le travail des éditeurs s'est borné uniquement à la révision des épreuves, et à la correction de ces légères inexactitudes de style, que échappent à la vue dans le manuscrit le plus soigné. Ce travail c'est fait sous les yeux de *M. A. W. de Schlegel, dont la rare supériorité d'esprit et de savoir justifie la confiance avec laquelle Madame de Stael le consultoit dans tous ses travaux litteraires*, autant que son honourable caractère mérite l'estime et l'amitié qu'elle n'a pas cessé d'avoir pour lui *pendant une liaison de treize années.*"

If any farther apology be necessary for quoting a French lady as an authority on German metaphysics, an obvious one is suggested by the extraordinary and well merited popularity of her *Allemagne* in this country. I

"At the epoch when this work was published (continues the same writer), there existed among thinking men only two systems concerning the human understanding: The one, that of Locke, ascribed all our ideas to our sensations;[1] the other, that of Descartes and of Leibnitz, had for its chief objects to demonstrate the spirituality and activity of the soul, the freedom of the will,[2] and, in short, the whole doctrines of the idealists. . . . .

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do not know, if, in any part of her works, her matchless powers have been displayed to greater advantage. Of this no stronger proof can be given, than the lively interest she inspires, even when discussing such systems as those of Kant and of Fichte.

[1] That this is a very incorrect account of Locke's philosophy, has been already shown at great length; but in this mistake Madame de Stael has only followed Leibnitz, and a very large proportion of the German philosophers of the present day. "The philosophy of sensation (says Frederick Schlegel), which was unconsciously bequeathed to the world by Bacon, and reduced to a methodical shape by Locke, first displayed in France the true immorality and destructiveness of which it is the parent, and assumed the appearance of a perfect system of Atheism." (*Lectures on the History of Literature*, from the German of Fred. Schlegel. Edin. 1818, Vol. II p. 22.) It is evident, that the system of Locke is here confounded with that of Condillac. May not the former be called the philosophy of *reflection*, with as great propriety as the philosophy of *sensation*?

[2] In considering Leibnitz as a partizan of the freedom of the will, Madame de Stael has also followed the views of many German writers, who make no distinction between Materialists and Necessitarians, imagining, that to assert the spirituality of the soul, is to assert its free-agency. On the inaccuracy of these conceptions it would be superfluous to enlarge, after what was formerly said in treating of the metaphysical opinions of Leibnitz.

In consequence of this misapprehension, Madame de Stael, and many other late writers on the Continent, have been led to employ, with a very exceptionable latitude, the word *Idealist*, to comprehend not only the advocates for the immateriality of the mind, but those also who maintain the Freedom of the Human Will! Between these two opinions, there is certainly no necessary connection; Leibnitz, and many other German metaphysicians, denying the latter with no less confidence than that with which they assert the former.

In England, the word *Idealist* is most commonly restricted to such as (with Berkeley) reject the existence of a material world. Of late, its meaning has been sometimes extended (particularly since the publication of Reid) to all those who retain the theory of Descartes and Locke, concerning the immediate objects of our perceptions and thoughts, whether they admit or reject the consequences deduced from this theory by the Berkeleians. In the present state of the science, it would contribute much to the distinctness of our reasonings were it to be used in this last sense exclusively.

There is another word to which Madame de Stael and other writers on the German philosophy annex an idea peculiar to themselves; I mean the word *experimental* or *empirical*. This epithet is often used by them to distinguish what they call the philosophy of Sensations, from that of Plato and of Leibnitz. It is accordingly generally, if not always, employed by them in an unfavourable sense. In this country, on the contrary, the experimental or inductive philosophy of the human mind denotes those speculations concerning mind, which, rejecting all hypothetical theories, rest solely on phenomena for which we have the evidence of consciousness. It is applied to the philosophy of Reid, and to all that is truly valuable in the metaphysical works of Descartes, Locke, Berkeley, and Hume.

Nor are the words *Experimental* and *Empirical* by any means synonymous in our language. The latter word is now almost exclusively appropriated to the practice of Medicine; and when so understood always

Between these extremes reason continued to wander, till Kant undertook to trace the limits of the two empires; of the senses and of the soul; of the external and of the internal worlds. The force of meditation and of sagacity, with which he marked these limits, had not perhaps any example among his predecessors." (*Allemagne*, Vol. III. pp. 70, 72.)

The praise bestowed on this part of Kant's philosophy, by one of his own pupils, is not less warm than that of Madame de Staël. I quote the passage, as it enters into some historical details which she has omitted, and describes more explicitly than she has done one of the most important steps, which Kant is supposed by his disciples to have made beyond his predecessors. In reading it, some allowances must be made for the peculiar phraseology of the German school.

" Kant *discovered* that the intuitive faculty of man is a compound of very dissimilar ingredients; or, in other words, that it consists of parts very different in their nature, each of which performs functions peculiar to itself; namely, the *sensitive faculty*, and the *understanding*. . . . . . Leibnitz, indeed, had likewise remarked the distinction subsisting between the sensitive faculty and the understanding; but he entirely overlooked the essential difference between their functions, and was of opinion that the faculties differed from one another only in degree. . . . . In the works of the English and French philosophers, we find this essential distinction between the sensitive and the intellectual faculties, and their combination towards producing one synthetical intuition scarcely mentioned. Locke only alludes to the accidental limitations of both faculties; but to inquire into the essential difference between them does not at all occur to him. . . . . . This distinction, then, between the sensitive and the intellectual faculties, forms an essential feature in the philosophy of Kant, and is, indeed, the basis upon which most of his subsequent inquiries are established." (*Elements of the Cri. Phil.* by A. F. M. Willich, M. D. pp. 68, 69, 70.)

It is a circumstance not easily explicable, that, in the foregoing historical sketch, no mention is made of the name of Cudworth, author of the treatise on *Eternal and Immutable Morality*; a book which could scarcely fail to be known, before the period in question, to

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implies a rash and unphilosophical use of Experience. " The appellation Empiric (says the late Dr John Gregory) is generally applied to one who, from observing the effects of a remedy in one case of a disease, applies it to all the various cases of that distemper." The same remark may be extended to the word *Empirique* in the French language, which is very nearly synonymous with *Charlatan*. In consequence of this abuse of terms, the epithet *experimental*, as well as *empirical*, is seldom applied by foreign writers to the philosophy of Locke, without being intended to convey a censure.

every German scholar, by the admirable Latin version of it published by Dr Mosheim.[1] In this treatise, Cudworth is at much pains to illustrate the Platonic doctrine concerning the difference between sensation and intellection; asserting that "some ideas of the mind proceed not from outward sensible objects, but arise from the inward activity of the mind itself;" that "even simple corporeal things, passively perceived by sense, are known and understood only by the active power of the mind;" and that, besides Αισθηματα and Φαντασματα, there must be Νοηματα or intelligible ideas, the source of which can be traced to the understanding alone.[2]

In the course of his speculations on these subjects, Cudworth has blended, with some very deep and valuable discussions, several opinions to which I cannot assent, and not a few

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[1] The first edition of this translation was printed as early as 1732. From Buhle's *History of Modern Philosophy* (a work which did not fall into my hands till long after this section was written), I find that Cudworth's *Treatise of Immutable Morality* is now not only well known to the scholars of Germany, but that some of them have remarked the identity of the doctrines contained in it with those of Kant. "Meiners, dans son histoire générale de l'Ethique nie que le système morale de Cudworth soit identique avec celui de Platon, et prétend au contraire, 'que les principes considérés comme appartenans de la manière la plus spéciale à la morale de Kant, étaient enseignes il y à deja plusieurs générations par l'école du philosophe Anglais." (*Hist. de la Phil. Moderne*, Tom. III. p. 577.) In opposition to this, Buhle states his own decided conviction—"qu'aucune des idées de Cudworth ne se rapproche de celles de Kant." (*Ibid.*) How far this conviction is well founded, the passage from Cudworth, quoted in the text, will enable my readers to judge for themselves.

That Cudworth has blended with his principles a vein of Platonic mysticism, which is not to be found in Kant, is undeniable; but it does not follow from this, that none of Kant's leading ideas are borrowed from the writings of Cudworth.

The assertion of Buhle, just mentioned, is the more surprising, as he himself acknowledges that—"La philosophie morale de Price présente en effet une analogie frappante avec celle de Kant;" and in another part of his work, he expresses himself thus on the same subject: "Le plus remarquable de tous les moralistes modernes de l'Angleterre est, sans contredit, Richard Price. . . . On remarque l'analogie la plus frappante entre ses idees sur les bases de la moralite, et celles que la philosophie critique à fait naitre en Allemagne, quoique il ne soit cependant pas possible d'élever le plus petit doute sur l'entière originalité de ces dernieres." (Tom. V. p. 308.) Is there any thing of importance in the system of Price, which is not borrowed from the *Treatise of Immutable Morality?* The distinguishing merit of this learned and most respectable writer is the good sense with which he has applied the doctrines of Cudworth to the sceptical theories of his own times.

In the sequel of Buhle's reflections on Cudworth's philosophy, we are told, that, according to him, "the will of God is only a simple blind power, acting mechanically or accidentally." ("Chez Cudworth la volonte même en Dieu, n'est qu'un simple pouvoir aveugle, agissant méchaniquement ou accidentellement.") If this were true, Cudworth ought to be ranked among the disciples, not of Plato, but of Spinoza.

[2] In this instance, a striking resemblance is observable between the language of Cudworth and that of Kant; both of them having followed the distinctions of the Socratic school, as explained in the *Theætetus* of Plato. They who are at all acquainted with Kant's *Critique*, will immediately recognize his phraseology in the passage quoted above.

propositions which I am unable to comprehend; but he seems to have advanced at least as far as Kant, in drawing the line between the provinces of the senses and of the understanding; and although not one of the most luminous of our English writers, he must be allowed to be far superior to the German metaphysician, both in point of perspicuity and of precision. A later writer, too, of our own country (Dr Price), a zealous follower both of Plato and of Cudworth, afterwards resumed the same argument, in a work which appeared long before the *Critique of Pure Reason;*[1] and urged it with much force against those modern metaphysicians, who consider the senses as the sources of all our knowledge. At a period somewhat earlier, many very interesting quotations of a similar import had been produced by the learned Mr Harris, from the later commentators of the Alexandrian school on the philosophy of Aristotle; and had been advantageously contrasted by him with the account given of the origin of our ideas, not only by Hobbes and Gassendi, but by many of the professed followers of Locke. If this part of the Kantian system, therefore, was new in Germany, it certainly could have no claim to the praise of originality, in the estimation of those at all acquainted with English literature.[2]

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[1] See a review of the *Principal Questions and Difficulties relating to Morals*, by Richard Price, D. D. London, 1758.

[2] I have mentioned here only those works of a modern date, which may be reasonably presumed to be still in general circulation among the learned. But many very valuable illustrations of the Platonic distinction between the senses and the understanding may be collected from the English writers of the seventeenth century. Among these it is sufficient to mention at present the names of John Smith and Henry More of Cambridge, and of Joseph Glanvile, the author of *Scepsis Scientifica.*

Cudworth's *Treatise of Eternal and Immutable Morality*, although it appears, from intrinsic evidence, to have been composed during the lifetime of Hobbes, was not published till 1731, when the author's manuscript came into the hands of his grandson, Francis Cudworth Masham, one of the Masters in Chancery. This work, therefore, could not have been known to Leibnitz, who died seventeen years before; a circumstance which may help to account for its having attracted so much less attention in Germany than his *Intellectual System*, which is repeatedly mentioned by Leibnitz in terms of the highest praise.

From an article in the *Edinburgh Review* (Vol. XXVII. p. 191), we learn, that large unpublished manuscripts of Dr Cudworth are deposited in the British Museum. It is much to be regretted (as the author of the article observes), that they should have been so long withheld from the public. "The press of the two Universities (he adds) would be properly employed in works, which a commercial publisher could not prudently undertake." May we not indulge a hope, that this suggestion will, sooner or later, have its due effect?

In the preface of Mosheim to his Latin version of the *Intellectual System*, there is a catalogue of Cudworth's unpublished remains, communicated to Mosheim by Dr Chandler then Bishop of Durham. Among these are two distinct works on the Controversy concerning Liberty and Necessity, of each of which works Mosheim has given us the general contents. One of the chapters is entitled, "Answer to the objection against Liberty, μηδὲν ἀναίτιον." It is not probable that it contains any thing very new or important; but it would certainly be worth while to know the reply made by Cudworth to an objection which both Leibnitz and La Place have fixed upon as decisive of the point in dispute.

In order, however, to strike at the root of what the Germans call the *philosophy of sensation*, it was necessary to trace, with some degree of systematical detail, the origin of our most important *simple notions;* and for this purpose it seemed reasonable to begin with an analytical view of those faculties and powers, to the exercise of which the developement of these notions is necessarily subsequent. It is thus that the simple notions of *time* and *motion* presuppose the exercise of the faculty of memory; and that the simple notions of *truth*, of *belief*, of *doubt*, and many others of the same kind, necessarily presuppose the exercise of the power of reasoning. I do not know, that, in this anatomy of the mind, much progress has hitherto been made by the German metaphysicians. A great deal certainly has been accomplished by the late Dr Reid; and something, perhaps, has been added to his labours by those of his successors.

According to Kant himself, his metaphysical doctrines first occurred to him while employed in the examination of Mr Hume's *Theory of Causation.* The train of thought by which he was led to them will be best stated in his own words; for it is in this way alone that I can hope to escape the charge of misrepresensation from his followers. Some of his details would perhaps have been more intelligible to my readers, had my plan allowed me to prefix to them a slight outline of Hume's philosophy. But this the general arrangement of my discourse rendered impossible; nor can any material inconvenience result in this instance, from the order which I have adopted, inasmuch as Hume's *Theory of Causation*, how new soever it may have appeared to Kant, is fundamentally the same with that of Malebranche, and of a variety of other old writers, both French and English.

[1] " Since the *Essays* (says Kant) of Locke and of Leibnitz, or rather since the origin of metaphysics, as far as their history extends, no circumstance has occurred, which might have been more decisive of the fate of this science than the attack made upon it by David Hume.[2] He proceeded upon a single but important idea in metaphysics, the connection of cause and effect, and the concomitant notions of power and action. He challenged *reason* to answer him what title she had to imagine, that any thing may be so constituted

[1] See the Preface of Kant to one of his Treatises, entitled *Prolegomena ad Metaphysicam quamque futuram quæ qua Scientia poterit prodire.* I have availed myself in the text of the English version of Dr Willich, from the German original, which I have carefully compared with the Latin version of Born. A few sentences, omitted by Willich, I have thought it worth while to quote, at the foot of the page, from the Latin translation. (*Elem. of Critical Philosophy*, by A. F. M. Willich, M. D. p. 10, *et seq.* London, 1798.)

[2] " *Humius.*—Qui quidem nullam huic cognitionis parti lucem adfudit, sed tamen excitavit scintillam, de quâ sane lumen potuisset accendi, si ea incidisset in fomitem, facile accipientem, cujusque scintillatio diligenter alta fuerit et aucta."

as that, if it be given, something else is also thereby inferred; for the idea of cause denotes this. He proved, beyond contradiction, that it is impossible for reason to think of such a connection *à priori*, for it contains *necessity*; but it is not possible to perceive how, because something is, something else must necessarily be; nor how the idea of such a connection can be introduced *à priori*.

"Hence, he concluded, that reason entirely deceives herself with this idea, and that she erroneously considers it as her own child, when it is only the spurious offspring of imagination, impregnated by experience; a *subjective* necessity, arising from habit and the association of ideas being thus substituted for an *objective* one derived from perception. . . . . However hasty and unwarrantable Hume's conclusion might appear, yet it was founded upon investigation; and this investigation well deserved, that some of the philosophers of his time should have united to solve, more happily if possible, the problem in the sense in which he delivered it: A complete reform of the science might have resulted from this solution. But it is a mortifying reflection, that his opponents, Reid, Beattie, Oswald, and, lastly, Priestley himself, totally misunderstood the *tendency* of his problem.[1] The question was not, whether the idea of cause be in itself proper and indispensable to the illustration of all natural knowledge, for this Hume had never doubted; but whether this idea be an object of thought through reasoning *à priori;* and whether, in this manner, it possesses internal evidence, independently of all experience; consequently, whether its utility be not limited to objects of sense alone. It was upon this point that Hume expected an explanation.[2]

"I freely own it was these suggestions of Hume's which first, many years ago, roused me from my dogmatical slumber, and gave to my inquiries quite a different direction in the field of speculative philosophy. I was far from being carried away by his conclusions, the fallacy of which chiefly arose from his not forming to himself an idea of the *whole of his problem*, but merely investigating a part of it, the solution of which was impossible without a comprehensive view of the whole. When we proceed on a well founded

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[1] "Non potest sine certo quodam molestiæ sensu percipi, quantopere ejus adversarii, *Reidius*, *Oswaldus*, *Beattius*, et tandem *Priestleius*, a scopo quæstionis abberrarent, et propterea, quod ea semper acciperent pro concessis, quæ ipse in dubium vocaret, contra vero cum vehementia, et maximam partem cum ingenti immodestia ea probare gestirent, quæ illi nunquam in mentem venisset dubitare, *nutum* ejus ad emendationem ita negligerent, ut omnia in statu pristino manerent, quasi nihil quidquam factum videretur."

[2] Although nothing can be more unjust than these remarks, in the unqualified form in which they are stated by Kant, it must, I think, be acknowledged, that some grounds for them have been furnished by occasional passages which dropped from the pens of most of Mr Hume's Scottish opponents.

though not thoroughly digested thought, we may expect, by patient and continued reflection, to prosecute it farther than the acute genius had done to whom we are indebted for the first spark of this light. I first enquired, therefore, whether Hume's objection might not be a general one, and soon found, that the idea of cause and effect is far from being the only one, by which the understanding *à priori* thinks of the connection of things; but rather that the science of metaphysics is altogether founded upon these connections. I endeavoured to ascertain their number; and, having succeeded in this attempt, I proceeded to the examination of those general ideas, which, I was now convinced, are not, as Hume apprehended, derived from experience, but arise out of the pure understanding. This deduction, which seemed impossible to my acute predecessor, and which nobody besides him had ever conceived, although every one makes use of these ideas, without asking himself upon what their objective validity is founded; this deduction, I say, was the most difficult which could have been undertaken for the behoof of metaphysics; and what was still more embarrassing, metaphysics could not here offer me the smallest assistance, because that deduction ought first to establish the possibility of a system of metaphysics. As I had now succeeded in the explanation of Hume's problem, not merely in a particular instance, but with a view of the whole power of pure reason, I could advance with sure though tedious steps, to determine completely, and upon general principles, the compass of Pure Reason, both what is the sphere of its exertion, and what are its limits; which was all that was required for erecting a system of metaphysics upon a proper and solid foundation."

It is difficult to discover any thing in the foregoing passage on which Kant could found a claim to the slightest originality. A variety of English writers had, long before this work appeared, replied to Mr Hume, by observing that the understanding is itself a source of new ideas, and that it is from this source that our notions of cause and effect are derived. "Our certainty (says Dr Price) that every new event requires some cause, depends no more on experience than our certainty of any other the most obvious subject of intuition. In the idea of every *change*, is included that of its being an *effect*."[1] In the works of Dr Reid, many remarks of the same nature are to be found; but, instead of quoting any of these, I shall produce a passage from a much older author, whose mode of thinking and writing mry perhaps be more agreeable to the taste of Kant's countrymen than the simplicity and precision aimed at by the disciples of Locke.

[1] *Review of the Principal Questions and Difficulties in Morals*, Chap. i. sect. 2. The first edition of this book was printed in 1758.

"That there are some ideas of the mind (says Dr Cudworth), which were not stamped or imprinted upon it from the sensible objects without, and therefore must needs arise from the innate vigour and activity of the mind itself, is evident, in that there are, *First*, Ideas of such things as are neither affections of bodies, nor could be imprinted or conveyed by any local motions, nor can be pictured at all by the fancy in any sensible colours; such as are the ideas of wisdom, folly, prudence, imprudence, knowledge, ignorance, verity, falsity, virtue, vice, honesty, dishonesty, justice, injustice, volition, cogitation, nay of sense itself, which is a species of cogitation, and which is not perceptible by any sense; and many other such like notions as include something of cogitation in them, or refer to cogitative beings only; which ideas must needs spring from the active power and innate fecundity of the mind itself,[1] because the corporeal objects of sense can imprint no such things upon it. *Secondly*, In that there are many relative notions and ideas, attributed as well to corporeal as incorporeal things, that proceed wholly from the activity of the mind comparing one thing with another. Such as are CAUSE, EFFECT, means, end, order, proportion, similitude, dissimilitude, equality, inequality, aptitude, inaptitude, symmetry, asymmetry, whole and part, genus and species, and the like."—*Immutable Morality*, pp. 148, 149.

It is not my business at present to inquire into the solidity of the doctrine here maintained. I would only wish to be informed what additions have been made by Kant to the reply given to Mr Hume by our English philosophers, and to direct the attention of my readers to the close resemblance between this part of Kant's system, and the argument which Cudworth opposed to Hobbes and Gassendi considerably more than a century ago.[2]

The following passage, from the writer last quoted, approaches so nearly to what Kant and other Germans have so often repeated of the distinction between *subjective* and *objective* truth, that I am tempted to connect it with the foregoing extract, as an additional proof that there are, at least, some metaphysical points, on which we need not search for instruction beyond our own island.

"If there were no other perceptive power, or faculty, distinct from external sense, all our perceptions would be merely relative, seeming, and fantastical, and not reach to the absolute and certain truth of any thing; and every one would but, as Protagoras expounds,

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[1] This is precisely the language of the German school: "Les verités necessaires (says Leibnitz) sont le produit immediat de l'activité interieure." (Tome I. p. 686 Tome II. pp. 42, 325. See Degerando, *Hist. Comp* Tome II. p. 96.)

[2] In the attempt, indeed, which Kant has made to enumerate all the general ideas which are not derived from experience, but arise out of the pure understanding, he may well lay claim to the praise of originality. On this subject I shall only refer my readers to Note (DD) at the end of this *Dissertation*

"thinks his own private and relative thoughts truths," and all our cogitations being nothing but appearances, would be indifferently alike true phantasms, and one as another.

"But we have since also demonstrated, that there is another perceptive power in the soul superior to outward sense, and of a distinct nature from it, which is the power of knowing or understanding, that is, an active exertion from the mind itself. And, therefore, has this grand eminence above sense, that it is no idiopathy, not a mere private, relative, seeming, and fantastical thing, but the comprehension of that which absolutely is and is not."[1]

After enlarging on the distinction between the sensitive faculty and the understanding, Kant proceeds to investigate certain essential conditions, without which neither the sensitive faculty nor its objects are conceivable. These conditions are *time* and *space*, which, in the language of Kant, are the *forms* of all phenomena. What his peculiar ideas are concerning their nature and attributes, my readers will find stated in his own words at the end of this Discourse, in an extract from one of his Latin publications.[2] From that extract, I cannot promise them much instruction; but it will at least enable them to judge for themselves of the peculiar character of Kant's metaphysical phraseology. In the mean time, it will be sufficient to mention here, for the sake of connection, that he denies the *objective* reality both of time and of space. The former he considers merely as a *subjective* condition, inseparably connected with the frame of the human mind, in consequence of which, it arranges sensible phenomena according to a certain law, in the order of succession. As to the latter, he asserts, that it is nothing *objective* or *real*, inasmuch as it is neither a substance, nor an accident, nor a relation; that its existence, therefore, is only *subjective* and *ideal*, depending on a fixed law, inseparable from the frame of the human mind. In consequence of this law, we are led to conceive all external things as placed in space; or (as Kant expresses it) we are led to consider *space as the fundamental form of every external sensation.*

In selecting Kant's speculations concerning *time* and *space*, as a specimen of his mode of writing, I was partly influenced by the consideration, that it furnishes, at the same time, a remarkable example of the concatenation which exists between the most remote and seemingly the most unconnected parts of his system. Who could suppose that his opinions on these subjects, the most abstract and the most controverted of any in the whole compass of metaphysics, bore on the great practical question of the freedom of the Human Will? The combination appears, at first sight, so very extraordinary, that I have no

[1] *Immutable Morality*, p. 264, *et seq.*

[2] See Note (EE.)

doubt I shall gratify the curiosity of some of my readers by mentioning a few of the intermediate steps which, in this argument, lead from the premises to the conclusion.

That Kant conceived the free agency of man to be necessarily implied in his moral nature (or, at least, that he was anxious to offer no violence to the common language of the world on this point), appears from his own explicit declarations in various parts of his works. "Voluntas libera (says he in one instance) eadem est cum voluntate legibus moralibus obnoxia."[1]

In all the accounts of Kant's philosophy, which have yet appeared from the pens of his admirers in this country, particular stress is laid on the ingenuity with which he has unloosed this knot, which had baffled the wisdom of all his predecessors. The following are the words of one of his own pupils, to whom we are indebted for the first, and, I think, not the least intelligible, view of his principles which has been published in our language.[2]

"Professor Kant is decidedly of opinion, that, although many strong and ingenious arguments have been brought forward in favour of the freedom of the will, they are yet very far from being decisive. Nor have they refuted the arguments urged by the Necessitarians, but by an appeal to mere feeling, which, on such a question, is of no avail. For this purpose, it is indispensably necessary to call to our assistance the principles of Kant."

"In treating this subject (continues the same author), Kant begins with showing that the notion of a Free Will is not contradictory. In proof of this he observes, that, although every human action, as an event in time, must have a cause, and so on *ad infinitum;* yet it is certain, that the laws of cause and effect can have a place there only where *time* is, for the effect must be consequent on the cause. But neither *time* nor *space* are properties of things; they are only the general *forms* under which man is allowed to view himself and the world. It follows, therefore, that man is not in time nor in space, al-

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[1] See Born's Latin Translation of Kant's Works relating to the *Critical Philosophy,* Vol. II. p. 325, *et seq.* See also the Preface to Vol. III.

[2] *A General and Introductory View of Professor Kant's Principles concerning Man, the World, and the Deity, submitted to the consideration of the Learned,* by F. A. Nitsch, late Lecturer on the Latin Language and Mathematics in the Royal Fredericianum College at Konigsberg, and Pupil of Professor Kant. London, 1796. Pp. 172, 173.

This small performance is spoken of in terms highly favourable, by the other writers who have attempted to introduce Kant's philosophy into England. It is called by Dr Willich *an excellent publication* (*Elements of the Critical Philosophy,* p. 62); and is pronounced by the author of the elaborate articles on that subject in the *Encyclopædia Londonensis* to be a *sterling work.* "Though at present very little known, I may venture (says this writer) to predict, that, as time rolls on, and prejudices moulder away, this work, like the *Elements of Euclid,* will stand forth as a lasting monument of PURE TRUTH."—See Note (FF.)

though the forms of his intuitive ideas are time and space. But if man exist not in time and space, he is not influenced by the laws of time and space, among which those of cause and effect hold a distinguished rank; it is, therefore, no contradiction to conceive, that, in such an order of things, man may be free."[1]

In this manner Kant establishes the *possibility* of man's freedom; and, farther than this, he does not conceive himself warranted to proceed on the principles of the critical philosophy. The first impression, certainly, which his argument produces on the mind is, that his own opinion was favourable to the scheme of necessity. For if the reasonings of the Necessitarians be admitted to be satisfactory, and if nothing can be opposed to them but the incomprehensible proposition, that man neither exists in space nor in time, the natural inference is, that this proposition was brought forward rather to save appearances, than as a serious objection to the universality of the conclusion.

Here, however, Kant calls to his aid the principles of what he calls *practical* reason. Deeply impressed with a conviction that morality is the chief concern of man, and that morality and the freedom of the human will must stand or fall together, he exerts his ingenuity to show, that the metaphysical proof already brought of the possibility of free-agency, joined to our own consciousness of a liberty of choice, affords evidence of the fact fully sufficient for the practical regulation of our conduct, although not amounting to what is represented as demonstration in the *Critique of Pure Reason*.[2]

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[1] Nitsch, &c. pp. 174, 175.

[2] The account of this part of Kant's doctrine given by M. Buhle agrees in substance with that of Mr Nitsch: " Toute moralité des actions repose uniquement sur la disposition practique, en tant qu'elle est déterminée par la loi morale seule. Si l'on considére cette disposition comme *phénomène* dans la conscience; c'est un événement naturel, elle obéit à la loi de la causalité, elle repose sur ce que l'homme a éprouvé auparavant dans le tems, et elle fait partie du caractère empirique de l'homme. Mais on peut aussi la considérer comme un acte de la liberté raisonnable: Alors elle n'est plus soumise à la loi de la causalité; elle est indépendante de la condition du temps, elle se rapporte à une cause intelligible, la liberté, et elle fait partie du caractère intelligible de l'homme. On ne peut, à la vérité, point acquerir la moindre connoissance des objets intelligibles; mais la liberté n'est pas moins un fait de la conscience. Donc les actions extérieures sont indifférentes pour la moralité de l'homme. La bonté morale de l'homme consiste uniquement dans sa volonté moralement bonne, et celle-ci consiste en ce que la volonté soit déterminée par la loi morale seule." (*Hist de la Philosophie Moderne*, par J. G. Buhle, Tom. VI. pp. 504, 505.)

Very nearly to the same purpose is the following statement by the ingenious author of the article *Leibnitz* in the *Biographie Universelle*: " Comment accorder le *fatum* et la liberté, l'imputation morale et la dépendence des êtres finies? Kant croit échapper à cet écueil en ne soumettant à la loi de causalité (au *déterminisme* de Leibnitz) que le monde phénoménique, et en affranchissant de ce principe l'ame comme *noumène* ou chose en soi, envisageant ainsi chaque action comme appartenant à un double série à la fois; à l'ordre physique où elle est enchainée à ce qui precède et à ce qui suit par les liens communs de la nature, et à l'ordre morale, ou une dé-

It is impossible to combine together these two parts of the Kantian system, without being struck with the resemblance they bear to the deceitful sense of liberty to which Lord Kames had recourse (in the *first* edition of his *Essays on Morality and Natural Religion*), in order to reconcile our consciousness of free-agency with the conclusions of the Necessitarians. In both cases, the reader is left in a state of most uncomfortable scepticism, not confined to this particular question, but extending to every other subject which can give employment to the human faculties.[1]

In some respects, the functions ascribed by Kant to his *practical* reason are analogous to those ascribed to common sense in the writings of Beattie and Oswald. But his view of the subject is, on the whole, infinitely more exceptionable than theirs, inasmuch as it sanctions the supposition, that the conclusions of *pure reason* are, in certain instances, at variance with *that* modification of reason which was meant by our Maker to be our guide in life; whereas the constant language of the other writers is, that all the different parts of our intellectual frame are in the most perfect harmony with each other. The motto which Beattie has prefixed to his book,

"Nunquam aliud natura, aliud sapientia dicit,"

expresses, in a few significant words, the whole substance of his philosophy.

It is to the same *practical* modification of reason that Kant appeals in favour of the existence of the Deity, and of a future state of retribution, both of which articles of belief he thinks derive the whole of their evidence from the moral nature of man. His system, therefore, as far as I am able to comprehend it, tends rather to represent these as useful *credenda*, than as certain or even as probable truths. Indeed, the whole of his moral superstructure will be found to rest ultimately on no better basis than the metaphysical *conundrum*, that the human mind (considered as a *noumenon* and not as a *phenomenon*) neither exists in space nor in time.

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termination produit un effet, sans que pour expliquer cette volition et son resultat, on soit renvoyé à un état antécédent."

The author of the above passage is M. Staffer, to whom we are indebted for the article *Kant* in the same work. For Kant's own view of the subject consult his *Critique of Pure Reason*, *passim*, particularly p. 99, *et seq.* of Born's *Translation*, Vol. III.

[1] The idea of Kant (according to his own explicit avowal) was, that every thing, which *conceives* itself to be free, whether it be in reality so or not, is rendered by its own belief a moral and accountable agent. "Jam equidem dico: quæque natura, quæ non potest, nisi *sub idea libertatis* agere, propter id ipsum, respectu practico, reipsa libera est; hoc est, ad eam valent cunctæ leges, cum libertate arctissime conjunctæ, perinde, ac

That it was Kant's original aim to establish a system of scepticism, I am far from being disposed to think.[1] The probability is, that he began with a serious wish to refute the doctrines of Hume; and that, in the progress of his inquiries, he met with obstacles of which he was not aware. It was to remove these obstacles that he had recourse to practical reason; an idea which has every appearance of being an *afterthought*, very remote from his views when he first undertook his work. This, too, would seem, from the following passage (which I translate from Degerando), to have been the opinion of one of Kant's ablest German commentators, M. Reinhold: "*Practical Reason* (as Reinhold ingeniously observes) is a wing which Kant has prudently added to his edifice, from a sense of the inadequacy of the original design to answer the intended purpose. It bears a manifest resemblance to what some philosophers call an appeal to *sentiment*, founding belief on the necessity of acting. Whatever contempt Kant may affect for popular systems of philosophy, this manner of considering the subject is not unlike the disposition of those who, feeling their inability to obtain, by the exercise of their reason, a direct conviction of their religious creed, cling to it nevertheless with a blind eagerness, as a support essential to their morals and their happiness." (*Hist Comparée*, Vol. II. pp. 243, 244.)

The extraordinary impression produced for a considerable time in Germany, by the *Critique of Pure Reason*, is very shrewdly, and I suspect justly, accounted for by the writer last quoted: "The system of Kant was well adapted to flatter the weaknesses of the hu-

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voluntas ejus etiam per se ipsam, et in philosophia theoretica probata, libera declaretur." (Kantii *Opera*, Vol. II. p. 326.)

This is also the creed professed by the Abbé Galiani, a much more dangerous moralist than Kant, because he is always intelligible, and often extremely lively and amusing. "L'homme est donc libre, puisqu'il est intimement persuadé de l'être, et que cela vaut tout autant que la liberté. *Voila donc le méchanisme de l'univers expliqué clair comme de l'eau de roche.*" The same author farther remarks, "La persuasion de la liberté constitue l'essence de l'homme. On pourroit même définir l'homme *un animal qui se croit libre*, et ce seroit une définition complète." (*Correspondance inedite de l'Abbé Galiani*, Tome I. pp. 339, 340. A Paris, 1818.)

[1] On the contrary, he declares explicitly (and I give him full credit for the sincerity of his words), that he considered his *Critique of Pure Reason* as the only effectual antidote against the opposite extremes of scepticism and of superstition, as well as against various heretical doctrines which at present infect the schools of philosophy. "Hâc igitur solâ (*Philosophia Criticâ*) et materialismi, et fatalismi, et Atheismi, et diffidentiæ profanæ, et fanatismi, et superstitionis, quorum virus ad universos potest penetrare, tandemque etiam et idealismi, et scepticismi, qui magis scholis sunt pestiferi, radices ipsæ possunt præcidi." (Kant, *Præf, Posterior*, p. xxxv.)

man mind. Curiosity was excited, by seeing paths opened which had never been trodden before. The love of mystery found a secret charm in the obscurity which enveloped the doctrine. The long and troublesome period of initiation was calculated to rouse the ambition of bold and adventurous spirits. Their love of singularity was gratified by the new nomenclature; while their vanity exulted in the idea of being admitted into a privileged sect, exercising, and entitled to exercise, the supreme censorship in philosophy. Even men of the most ordinary parts, on finding themselves called to so high functions, lost sight of their real mediocrity, and conceived themselves transformed into geniuses destined to form a new era in the history of reason.

" Another inevitable effect resulting from the universal change operated by Kant in his terms, in his classifications, in his methods, and in the enunciation of his problems. The intellectual powers of the greater part of the initiated were too much exhausted in the course of their long noviciate, to be qualified to judge soundly of the doctrine itself. They felt themselves, after so many windings, lost in a labyrinth, and were unable to dispense with the assistance of the guide who had conducted them so far. Others, after so great a sacrifice, wanted the courage to confess to the world, or to themselves, the disappointment they had met with. They attached themselves to the doctrine in proportion to the sacrifice they had made, and estimated its value by the labour it had cost them. As for more superficial thinkers, they drew an inference from the novelty of the form in favour of the novelty of the matter, and from the novelty of the matter in favour of its importance.

" It is a great advantage for a sect to possess a distinguishing garb and livery. It was thus that the Peripatetics extended their empire so widely, and united their subjects in one common obedience. Kant had, over and above all this, the art of insisting, that his disciples should belong exclusively to himself. He explicitly announced, that he was not going to found a school of Ecclectics, but a school of his own; a school not only independent, but in some measure hostile to every other; that he could admit of no compromise with any sect whatever; that he was come to overturn every thing which existed in philosophy, and to erect a new edifice on these immense ruins. The more decided and arrogant the terms were in which he announced his design, the more likely was it to succeed; for the human mind submits more easily to an unlimited than to a partial faith, and yields itself up without reserve, rather than consent to cavil about restrictions and conditions even in favour of its own independence."

With these causes of Kant's success another seems to have powerfully conspired; the indissoluble coherence and concatenation of all the different parts of his philosophy. " It is on this concatenation (says M. Prevost) that the admiration of Kant's followers is

chiefly founded." *Grant only* (they boast) *the first principles of the Critical Philosophy, and you must grant the whole system.* The passage quoted on this occasion by M. Prevost is so forcibly expressed, that I cannot do it justice in an English version: "Ab hinc enim capitibus fluere necesse est omnem philosophiæ criticæ rationis puræ vim atque virtutem; namque in ea contextus rerum prorsus mirabilis est, ita ut extrema primis, media utrisque, omnia omnibus respondeant; si prima dederis danda sunt omnia."[1] No worse account could well have been given of a philosophical work on such a subject; nor could any of its characteristical features have been pointed out more symptomatic of its ephemeral reputation. Supposing the praise to be just, it represented the system, however fair and imposing in its first aspect, as vitally and mortally vulnerable (if at all vulnerable) in every point; and, accordingly, it was fast approaching to its dissolution before the death of its author. In Germany, at present, we are told, that a pure Kantian is scarcely to be found.[2] But there are many Semi-Kantians and Anti-Kantians as well as partisans of other schemes built out of the ruins of the Kantian philosophy.[3] "In fine (says a late author), the *Critique of Pure Reason,* announced with pomp, received with fanaticism, disputed about with fury, after having accomplished the overthrow of the doctrines taught by Leibnitz and Wolff, could no longer support itself upon its own foundations, and has produced no permanent result, but divisions and enmities, and a general disgust at all systematical creeds."[4] If this last effect has really resulted from it (of which some doubts may perhaps be entertained), it may be regarded as a favourable symptom of a sounder taste in matters of abstract science, than has ever yet prevailed in that country.[5]

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[1] See some very valuable strictures on Kant, in the learned and elegant sketch of the present state of philosophy, subjoined to M. Prevost's French translation of Mr Smith's posthumous works. The Latin panegyric on the critical philosophy is quoted from a work with which I am unacquainted, *Fred. Gottlob Bornii de Scientia et Conjectura.*

[2] On this subject, see Degerando, Tom. II. p. 333.

[3] See Degerando, and de Bonald.

[4] The words in the original are, "Un dégôut générale de toute doctrine." But as the same word *doctrine* is, in a former part of the same sentence, applied to the systems of Leibnitz and of Wolff, I have little doubt, that, in substituting for *doctrine* the phrase *systematical creeds,* I have faithfully rendered the meaning of my author. (See *Recherches Philosophiques,* par M. de Bonald, Tom. I. pp. 43, 44.)

[5] The passion of the Germans for *systems* is a striking feature in their literary taste, and is sufficient of itself to show, that they have not yet passed their noviciate in philosophy. "To all such (says Mr Maclaurin) as have just notions of the Great Author of the universe, and of his admirable workmanship, all complete and finished systems must appear very suspicious." At the time when he wrote, such systems had not wholly lost their partisans in England; and the name of *System* continued to be a favourite title for a book even among writers of the highest reputation. Hence the *System of Moral Philosophy* by

To these details, I have only to add a remark of Degerando's, which I have found amply confirmed within the circle of my own experience. It might furnish matter for some useful reflections, but I shall leave my readers to draw their own conclusions from it. "Another remarkable circumstance is, that the defence of the Kantians turned, in general, not upon the *truth* of the disputed proposition, but upon the right interpretation of their master's meaning, and that their reply to all objections has constantly begun and ended with these words, *You have not understood us.*"

Among the various schools which have emanated from that of Kant, those of Fichte and Schelling seem to have attracted among their countrymen the greatest number of proselytes. Of neither am I able to speak from my own knowledge; nor can I annex any distinct idea to the accounts which are given of their opinions by others. Of Fichte's speculations about the philosophical import of the pronoun *I* (*Qu'est-ce que le moi?* as Degerando translates the question), I cannot make any thing. In some of his remarks, he approaches to the language of those Cartesians who, in the progress of their doubts, ended in absolute *egoism:* but the *ego* [1] of Fichte has a creative power. It creates *existence*, and it creates *science*; two things (by the way) which, according to him, are one and the same. Even *my own* existence, he tells me, commences only with the *reflex act*, by which I think of the pure and primitive *ego*. On this identity of the intelligent *ego* and the existing *ego* (which Fichte expresses by the formula ego = ego) all science ultimately rests.—But on this part of his metaphysics it would be idle to enlarge, as the author acknowledges, that it is not to be understood without the aid of a certain *transcendental sense*, the want of which is wholly irreparable; a singular admission enough (as Degerando observes), on the part of those critical philosophers who have treated with so much contempt the appeal to *Common Sense* in the writings of some of their predecessors. [2]

Hutcheson, and the *Complete System of Optics* by Smith, titles which, when compared with the subsequent progress of these two sciences, reflect some degree of ridicule upon their authors.

When this affectation of systematical method began, in consequence of the more enlarged views of philosophers, to give way to that aphoristical style so strongly recommended and so happily exemplified by Lord Bacon, we find some writers of the old school complaining of the innovation, in terms not unlike those in which the philosophy of the English has been censured by some German critics. "The best way (says Dr Watts) to learn any science, is to begin with a regular system. Now (he continues), we deal much in essays, and unreasonably despise systematical learning; whereas our fathers had a just value for regularity and systems." Had Dr Watts lived a few years later, I doubt not that his good sense would have led him to retract these hasty and inconsiderate decisions.

[1] In order to avoid the intolerable awkwardness of such a phrase as *the I*, I have substituted on this occasion the Latin pronoun for the English one.

[2] *Hist. Comparée*, &c. Tome II. pp. 300, 301. See also the article Fichte in this *Supplement*.

"In the history of beings there are (according to Fichte) three grand epochs; the first belongs to the empire of *chance*; the second is the reign of *nature;* the third *will be* the epoch of the existence of *God*. For God does not exist yet; he only manifests himself as preparing to exist. Nature tends to an apotheosis, and may be regarded as a sort of divinity in the germ."[1]

The account given by Madame de Staël of this part of Fichte's system is considerably different: "He was heard to say, upon one occasion, that in his next lecture he 'was going to create God,'—an expression which, not without reason, gave general offence. His meaning was, that he intended to show how the idea of God arose and unfolded itself in the mind of man."[2] How far this apology is well-founded, I am not competent to judge.

The system of Schelling is, in the opinion of Degerando, but an extension of that of Fichte; connecting with it a sort of Spinozism grafted on Idealism. In considering the primitive *ego* as the source of all reality as well as of all science, and in thus transporting the mind into an intellectual region, inaccessible to men possessed only of the ordinary number of senses, both agree; and to this vein of transcendental mysticism may probably be ascribed the extraordinary enthusiasm with which their doctrines appear to have been received by the German youth. Since the time when Degerando wrote, a new and very unexpected revolution is said to have taken place among Schelling's disciples; many of them, originally educated in the Protestant faith, having thrown themselves into the bosom of the Catholic church.[3] . . . . . . "The union of the faithful of this school forms an invi-

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[1] *Hist. Comparée,* &c. Tome II. p. 314. The doctrine here ascribed to Fichte by Degerando, although its unparalleled absurdity might well excite some doubts about the correctness of the historian, is not altogether a novelty in the history of philosophy. It is in point of fact nothing more than a return to those gross conceptions of the mind in the infancy of human reason, which Mr Smith has so well described in the following passage. "In the first ages of the world, the seeming incoherence of the appearances of nature so confounded mankind, that they despaired of discovering in her operations any regular system. . . . . . Their gods, though they were apprehended to interpose upon some particular occasions, were so far from being regarded as the creators of the world, that their origin was apprehended to be posterior to that of the world. The earth (according to Hesiod) was the first production of the chaos. The heavens arose out of the earth, and from both together, all the gods who afterwards inhabited them. Nor was this notion confined to the vulgar, and to those poets who seem to have recorded the vulgar theology. . . . . The same notion of the spontaneous origin of the world was embraced (as Aristotle tells us) by the early Pythagoreans. . . Mind, and understanding, and consequently Deity, being the most perfect, were necessarily, according to them, the last productions of nature. For, in all other things, what was most perfect, they observed, always came last: As in plants and animals, it is not the seed that is most perfect, but the complete animal, with all its members in the one; and the complete plant, with all its branches, leaves, flowers, and fruits, in the other."—Smith's *Post. Essays on Philosophical Subjects*, pp. 106, 107.

[2] *De l'Allemagne.* Tome III. p. 107. Londres, 1813.

[3] See a paper by M. G. Schweighauser in the London *Monthly Magazine* for 1804, p. 207.

sible church, which has adopted for its symbol and watch-word, the Virgin Mary; and hence rosaries are sometimes to be seen in the hands of those who reckon Spinoza among the greatest prophets." It is added, however, with respect to this invisible church, that "its members have embraced the Catholic religion, not as the *true* religion, but as the most *poetical;*" a thing not improbable among a people who have so strong a disposition to mingle together poetry and metaphysics in the same compositions.[1] But it is painful to contemplate these sad aberrations of human reason; nor would I have dwelt on them so long as I have done, had I not been anxious to convey to my readers a general, but I trust not unfaithful, idea of the style and spirit of a philosophy, which, within the short period of our recollection, rose, flourished, and fell; and which, in every stage of its history, furnished employment to the talents of some of the most learned and able of our contemporaries.[2]

The space which I have allotted to Kant has so far exceeded what I intended he should occupy, that I must pass over the names of many of his countrymen much more worthy of public attention. In the account given by Degerando of the opponents to the Kantian system, some remarks are quoted from different writers, which convey a very favourable idea of the works from which they are borrowed. Among these I would more particularly distinguish those ascribed to Jacobi and to Reinhold. In the Memoirs, too, of the Berlin Academy, where (as Degerando justly observes) the philosophy of Locke found an asylum, while banished from the rest of Germany, there is a considerable number of metaphysical articles of the highest merit.[3] Nor must I omit to mention the con-

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[1] "Aussi les Allemands mêlent ils trop souvent la Métaphysique à la Poésie." (*Allemagne,* Vol. III. p. 133.) "Nothing (says Mr Hume) is more dangerous to reason than the flights of imagination, and nothing has been the occasion of more mistakes among philosophers. Men of bright fancies may, in this respect, be compared to those angels, whom the Scripture represents as covering their eyes with their wings." (*Treatise on Human Nature,* Vol. I. p. 464.)

[2] According to a French writer, who appears to have resided many years in Germany, and who has enlivened a short Essay on the *Elements of Philosophy* with many curious historical details concerning Kant and his successors,—both Fichte and Schelling owed much of their reputation to the uncommon eloquence displayed in their academical lectures: "Cette doctrine sortait de la bouche de Fichte, revêtue de ces ornemens qui séduisent la jeunesse, la beauté et la force au discours. On ne se lassait point en l'écoutant."

Of Schelling he expresses himself thus: "Schelling, appelé à l'université de Wirzbourg, y attira par sa réputation un concours nombreux d'auditeurs, qu'il enchainait à ses leçons par la richesse de sa diction et par l'etendue de ses connoisances. De là, il est venu à Munich, ou je le revis en 1813. On dit qu'il a embrassé la religion Catholique." (*Essai sur les Elémens de la Philosophie,* par G. Gley, Principal au College d'Alençon. Paris, 1817. pp. 152, 138.)

[3] In a volume of this collection (for the year 1797), which happens to be now lying before me, there

tributions to this science by the university of Goettingen; more especially on questions connected with the philosophy of language. I have great pleasure, also, in acknowledging the entertainment I have received, and the lights I have borrowed from the learned labours of Meiners and of Herder; but none of these are so closely connected with the history of metaphysics as to justify me in entering into particular details with respect to them. I am ashamed to say that, in Great Britain, the only one of these names which has been much talked of is that of Kant, a circumstance which, I trust, will apologize for the length to which the foregoing observations have extended.[1]

The only other country of Europe from which any contributions to metaphysical philosophy could be reasonably looked for, during the eighteenth century, is Italy; and to this particular branch of science I do not know that any Italian of much celebrity has, in these later times, turned his attention. The metaphysical works of Cardinal Gerdil (a native of Savoy) are extolled by some French writers; but none of them have ever happened to fall in my way.[2] At a more recent period, Genovesi, a Neapolitan philosopher[3] (best known as a political economist), has attracted a good deal of notice by some metaphysical publications. Their chief object is said to be to reconcile, as far as possible, the opinions of Leibnitz with those of Locke. "Pendant que Condillac donnait inutilement

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are three profound and important *Memoirs on Probabilities*, by M. Prevost and M l'Huillier. Neither of these authors, I am aware, is of German origin, but as the Academy of Berlin has had the merit to bring their papers before the public, I could not omit this opportunity of recommending them to the attention of my readers. To a very important observation made by MM. Prevost and l'Huillier, which has been the subject of some dispute, I am happy to avail myself of the same opportunity to express my unqualified assent. (See pp 15 and 31 of the memoirs belonging to the *Classe de Philosophie Speculative*.)

[1] See Note (GG)

[2] His two first publications, which were directed against the philosophy of Locke (if we may judge from their titles), are not likely, in the present times, to excite any curiosity. 1. *The Immateriality of the Soul Demonstrated against Mr Locke, on the same Principles on which this Philosopher has Demonstrated the Existence and the Immateriality of God.* Turin, 1747. 2. *Defence of the Opinion of Malebranche, on the Nature and Origin of our ideas, against the Examination of Mr Locke.* Turin, 1748. The only other works of Gerdil which I have seen referred to are, *A Dissertation on the Incompatibility of the Principles of Descartes with those of Spinoza*, and *A Refutation of some Principles maintained in the Emile of Rousseau.*

Of this last performance, Rousseau is reported to have said, "*Voila l'unique ecrit publie contre moi que j'aie trouvé digne d'être lu en entier.*" (*Nouveau Dict. Hist.* article *Gerdil*) In the same article, a reference is made to a public discourse of the celebrated M. Mairan, of the Academy of Sciences, in which he pronounces the following judgment on Gerdil's metaphysical powers: "*Gerdil porte avec lui dans tous ces discours un esprit géometrique, qui manque trop souvent aux geométres mêmes.*"

[3] Born 1712, died 1769.

des leçons à un Prince d'Italie, Genovesi en donnait avec plus de succès à ses élèves Napolitans : il combinait le mieux qu'il lui etoit possible les theories de Leibnitz pour lequel il eut toujours une prevention favorable, avec celle de Locke, qu'il accrédita le premier en Italie."[1] Various other works of greater or of less celebrity, from Italian authors, seems to announce a growing taste in that part of Europe for these abstract researches. The names of Francisco Soave, of Biagioli, and of Mariano Gigli, are advantageously mentioned by their countrymen; but none of their works, as far as I can learn, have yet reached Scotland. Indeed, with the single exception of Boscovich, I recollect no writer on the other side of the Alps, whose metaphysical speculations have been heard of in this island. This is the more to be regretted, as the specimens he has given, both of originality and soundness in some of his abstract discussions, convey a very favourable idea of the school in which he received his education. The authority to which he seems most inclined to lean is that of Leibnitz; but, on all important questions he exercises his own judgment, and often combats Leibnitz with equal freedom and success. Remarkable instances of this occur in his strictures on the principle of *the sufficient reason*, and in the limitations with which he has admitted the *law of continuity*.

The vigour, and, at the same time, the versatility of talents, displayed in the voluminous works of this extraordinary man, reflect the highest honour on the country which gave

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[1] *Revue Encyclopédique, ou Analyse Raissonnée des Productions les plus Remarquables dans la Littérature, les Sciences, et les Arts.* I. Vol. 3me livraison, p. 515. Paris, Mars 1819. (The writer of the article quoted in the text is M. Sarpi, an Italian by birth, who, after having distinguished himself by various publications in his own country, has now (if I am not mistaken) fixed his residence at Paris. In his own philosophical opinions, he seems to be a follower of Condillac's school, otherwise he would scarcely have spoken so highly as he has done of the French Ideologists : " L'Idéologie qui, d'apres sa denomination récente pourrait être considerée comme specialement due aux Français, mais qui est aussi ancienne que la philosophie, puisqu'elle a pour objet la génération des idées et l'analyse des facultés qui concourent à leur formation, n'est pas étrangère aux Italiens, comme on pourrait le croire ")

Genovesi is considered, by an historian of high reputation, as the reformer of Italian philosophy. If the execution of his *Treatise on Logic* corresponds at all to the enlightened views with which the design seems to have been conceived, it cannot fail to be a work of much practical utility. " Ma chi può veramente dirsi il riformatore dell' Italiana filosofia, chi la fece tosto conoscere, e respettare da' più dotti filosofi delle altre nazioni, chi seppe arricchire di nuovi pregi la logica, la metafisica, e la morale, fu il celebre Genovesi. Tuttochè molti fossero stati i filosofi che cercarono con sottili riflessioni, e giusti precetti d'ajutare la mente a pensare ed a ragionare con esattezza e verità, e Bacone, Malebranche, Loke, Wolfio, e molt' altri sembrassero avere esaurito quanto v'era da scrivere su tale arte, seppe nondimeno il Genovesi trovare nuove osservazioni, e nuovi avvertimenti da preporre, e dare una logica più piena e compiuta, e più utile non solo allo studio della filosofia, e generalmente ad ogni studio scientifico, ma eziandio alla condotta morale, ed alla civile società." (*Dell' Origine, de Progressi, e dello Stato attuale d'Ogni Letteratura* dell' Abate D. Giovanni Andres. Tomo XV. pp. 260, 261, Venezia, 1800.)

him birth, and would almost tempt one to give credit to the theory which ascribes to the genial climates of the south a beneficial influence on the intellectual frame. Italy is certainly the only part of Europe where mathematicians and metaphysicians of the highest rank have produced such poetry as has proceeded from the pens of Boscovich and Stay. It is in this rare balance of imagination, and of the reasoning powers, that the perfection of the human intellect will be allowed to consist; and of this balance a far greater number of instances may be quoted from Italy (reckoning from Galileo[1] downwards), than in any other corner of the learned world.

The sciences of ethics, and of political economy, seem to be more suited to the taste of the modern Italians, than logic or metaphysics, properly so called. And in the two former branches of knowledge, they have certainly contributed much to the instruction and improvement of the eighteenth century. But on these subjects we are not yet prepared to enter.

In the New World, the state of society and of manners has not hitherto been so favourable to abstract science as to pursuits which come home directly to the business of human life. There is, however, *one* metaphysician of whom America has to boast, who, in logical acuteness and subtility, does not yield to any disputant bred in the universities of Europe. I need not say, that I allude to Jonathan Edwards. But, at the time when he wrote, the state of America was more favourable than it now is, or can for a long period be expected to be, to such inquiries as those which engaged his attention; inquiries (by the way) to which his thoughts were evidently turned, less by the impulse of speculative curiosity, than by his anxiety to defend the theological system in which he had been educated, and to which he was most conscientiously and zealously attached The effect of this anxiety in sharpening his faculties, and in keeping his polemical vigilance constantly *on the alert*, may be traced in every step of his argument.[2]

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[1] See a most interesting account of Galileo's taste for poetry and polite literature in Ginguené, *Histoire Littéraire d'Italie*. Tome V. pp. 331, *et seq* à Paris, 1812.

[2] While this *Dissertation* was in the press, I received a new American publication, entitled, "*Transactions of the Historical and Literary Committee of the American Philosophical Society, held at Philadelphia, for Promoting Useful Knowledge*," Vol. I. (Philadelphia, 1819.) From an advertisement prefixed to this volume, it appears that, at a meeting of this learned body in 1815, it was resolved, "That a new committee be added to those already established, to be denominated the Committee of History, Moral Science, and General Literature." It was with great pleasure I observed, that one of the first objects to which the committee has directed its attention is to investigate and ascertain, as much as possible, the structure and grammatical forms of the languages of the aboriginal nations of America. The *Report* of the corresponding secretary (M Duponceau), dated January 1819, with respect to the progress then made in this investigation, is highly curious and interesting, and displays not only enlarged and philosophical views, but an intimate acquaintance with the philo-

In the mean time, a new and unexpected mine of intellectual wealth has been opened to the learned of Europe, in those regions of the East; which, although in all probability the cradle of civilization and science, were, till very lately, better known in the annals of commerce than of philosophy. The metaphysical and ethical remains of the Indian sages are, in a peculiar degree, interesting and instructive; inasmuch as they seem to have furnished the germs of the chief systems taught in the Grecian schools. The favourite theories, however, of the Hindoos will, all of them, be found, more or less, tinctured with those ascetic habits of abstract and mystical meditation which seem to have been, in all ages, congenial to their constitutional temperament. Of such habits, an Idealism, approaching to that of Berkeley and Malebranche, is as natural an offspring, as Materialism is of the gay and dissipated manners, which, in great and luxurious capitals, are constantly inviting the thoughts abroad.

To these remains of ancient science in the East, the attention of Europe was first called by Bernier, a most intelligent and authentic traveller, of whom I formerly took notice as a favourite pupil of Gassendi. But it is chiefly by our own countrymen that the field which he opened has been subsequently explored; and of their meritorious labours in the prosecution of this task, during the reign of our late Sovereign, it is scarcely possible to form too high an estimate.

Much more, however, may be yet expected, if such a prodigy as Sir William Jones should again appear, uniting, in as miraculous a degree, the gift of tongues with the spirit of philosophy. The structure of the Sanscrit, in itself, independently of the treasures locked up in it, affords one of the most puzzling subjects of inquiry that was ever presented to human ingenuity. The affinities and filiations of different tongues, as evinced

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logical researches of Adelung, Vater, Humboldt, and other German scholars All this evinces an enlightened curiosity, and an extent of literary information, which could scarcely have been expected in these rising states for many years to come.

The rapid progress which the Americans have lately made in the art of writing has been remarked by various critics, and it is certainly a very important fact in the history of their literature. Their state papers were, indeed, always distinguished by a strain of animated and vigorous eloquence; but as most of them were composed on the spur of the occasion, their authors had little time to bestow on the niceties, or even upon the purity of diction. An attention to these is the slow offspring of learned leisure, and of the diligent study of the best models. This I presume was Gray's meaning, when he said, that "good writing not only required great parts, but the very best of those parts;" * a maxim which, if true, would point out the state of the public taste with respect to style, as the surest test among any people of the general improvement which their intellectual powers have received; and which, when applied to our Trans-atlantic brethren, would justify sanguine expectations of the attainments of the rising generation.

* Note of Mason on a Letter of Gray's to Dr Wharton, on the death of Dr Middleton.

in their corresponding roots and other coincidences, are abundantly curious, but incomparably more easy in the explanation, than the systematical analogy which is said to exist between the Sanscrit and the Greek (and also between the Sanscrit and the Latin, which is considered as the most ancient dialect of the Greek), in the conjugations and flexions of their verbs, and in many other particulars of their mechanism; an analogy which is represented as so complete, that, in the versions which have been made from the one language into the other, "Sanscrit," we are told, "answers to Greek, as face to face in a glass."[1] That the Sanscrit did not grow up to the perfection which it now exhibits, from popular and casual modes of speech, the unexampled regularity of its forms seems also to demonstrate, and yet, should this supposition be rejected, to what other hypothesis shall we have recourse, which does not involve equal, if not greater improbabilities? The problem is well worthy of the attention of philosophical grammarians; and the solution of it, whatever it may be, can scarcely fail to throw some new lights on the history of the human race, as well as on that of the human mind.

SECTION VIII.

Metaphysical Philosophy of Scotland.

It now only remains for me to take a slight survey of the rise and progress of the Metaphysical Philosophy of Scotland; and if, in treating of this, I should be somewhat more minute than in the former parts of this Historical Sketch, I flatter myself that allowances will be made for my anxiety to supply some chasms in the literary history of my country, which could not be so easily, nor perhaps so authentically, filled up by a younger hand.

The Metaphysical Philosophy of Scotland, and, indeed, the literary taste in general, which so remarkably distinguished this country during the last century, may be dated from the lectures of Dr Francis Hutcheson, in the University of Glasgow. Strong indications of the same speculative spirit may be traced in earlier writers;[2] but it was from this period

[1] Letter from the Reverend David Brown, Provost of the College of Fort-William, about the *Sanscrit Edition of the Gospels*, (dated Calcutta, September 1806, and published in some of the *Literary Journals* of the day.)

[2] See Note (HH.)

that Scotland, after a long slumber, began again to attract general notice in the republic of letters.[1]

The writings of Dr Hutcheson, however, are more closely connected with the history of Ethical than of Metaphysical Science; and I shall, accordingly, delay any remarks which I have to offer upon them till I enter upon that part of my subject. There are, indeed, some very original and important metaphysical hints scattered over his works; but it is chiefly as an ethical writer that he is known to the world, and that he is entitled to a place among the philosophers of the eighteenth century.[2]

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[1] An Italian writer of some note, in a work published in 1763, assigns the same date to the revival of letters in Scotland. "Fra i tanti, e si chiari Scrittori che fiorirono nella Gran Bretagna a' tempi della Regina Anna, non se ne conta pur uno, che sia uscito di Scozia ...... Francesco Hutcheson venuto in Iscozia, a professarvi la Filosofia, e gli studii di umanità, nella Universita di Glasgow, v'insinuò per tutto il paese colle istruzione a viva voce, e con egregie opere date alle stampe, un vivo genio per gli studii filosofici, e literarii, e sparse qui fecondissimi semi, d'onde vediamo nascere si felice frutti, e si copiose." (*Discorso sopra le Vicende della Litteratura, del Sig.* Carlo Denina, p. 224, Glasgow edit. 1763.)

I was somewhat surprised to meet with the foregoing observations in the work of a foreigner, but, wherever he acquired his information, it evinces, in those from whom it was derived, a more intimate acquaintance with the traditionary history of letters in this country than has fallen to the share of most of our own authors who have treated of that subject. I have heard it conjectured, that the materials of his section on Scottish literature had been communicated to him by Mr. Hume.

Another foreign writer, much better qualified than Denina to appreciate the merits of Hutcheson, has expressed himself on this subject with his usual precision. "L'ecole Ecossaise a en quelque sorte pour fondateur Hutcheson maitre et prédécesseur de Smith. C'est ce philosophe qui lui a imprimé son caractère, et qui a commencé à lui donner de l'eclat." In a note upon this passage the author observes,—"C'est en ce seul sens qu'on peut donner un chef à une école de philosophie qui, comme on le verra, professe d'ailleurs la plus parfaite indépendance de l'autorité."—(See the excellent reflections upon the posthumous works of Adam Smith, annexed by M. Prevost to his translation of that work.)

Dr Hutcheson's first course of lectures at Glasgow was given in 1730. He was a native of Ireland, and is accordingly called by Denina "un dotto Irlandese;" but he was of Scotch extraction (his father or grandfather having been a younger son of a respectable family in Ayrshire), and he was sent over when very young to receive his education in Scotland.

[2] One of the chief objects of Hutcheson's writings was to oppose the licentious system of Mandeville; a system which was the natural offspring of some of Locke's reasonings against the existence of innate practical principles.

As a moralist, Hutcheson was a warm admirer of the ancients, and seems to have been particularly smitten with that favourite doctrine of the Socratic school which identifies the *good* with the *beautiful*. Hence he was led to follow much too closely the example of Shaftesbury, in considering moral distinctions as founded more on sentiment than on reason, and to speak vaguely of virtue as a sort of *noble enthusiasm;* but he was led, at the same time, to connect with his ethical speculations some collateral inquiries concerning Beauty and Harmony, in which he pursued, with considerable success, the path recently struck out by Addison in his *Essays on the Pleasures of the Imagination.* These inquiries of Hutcheson, together with his *Thoughts*

Among the contemporaries of Dr Hutcheson, there was one Scottish metaphysician (Andrew Baxter, author of the *Inquiry into the Nature of the Human Soul*), whose name it would be improper to pass over without some notice, after the splendid eulogy bestowed on his work by Warburton. "He who would see the justest and precisest notions of God and the soul may read this book, one of the most finished of the kind, in my humble opinion, that the present times, greatly advanced in true philosophy, have produced."[1]

To this unqualified praise, I must confess, I do not think Baxter's *Inquiry* altogether entitled, although I readily acknowledge that it displays considerable ingenuity, as well as learning. Some of the remarks on Berkeley's argument against the existence of matter are acute and just, and, at the time when they were published, had the merit of novelty.

One of his distinguishing doctrines is, that the Deity is the *immediate* agent in producing the phenomena of the *Material World;* but that, in the *Moral World*, the case is different,—a doctrine which, whatever may be thought of it in other respects, is undoubtedly a great improvement on that of Malebranche, which, by representing God as the only agent in the universe, was not less inconsistent than the scheme of Spinoza with the moral nature of Man. "The Deity (says Baxter) is not only at the head of Nature, but in every part of it. A chain of material causes betwixt the Deity and the effect produced, and much more a series of them, is such a supposition as would conceal the Deity from the knowledge of mortals for ever. We might search for matter above matter, till we were lost in a labyrinth out of which no philosopher ever yet found his way.—This way of bringing in second causes is borrowed from the government of the moral world, where free agents act a part; but it is very improperly applied to the material universe, where matter and motion only (or mechanism, as it is called) comes in competition with the Deity."[2]

Notwithstanding, however, these and other merits, Baxter has contributed so little to the advancement of that philosophy which has since been cultivated in Scotland, that I am afraid the very slight notice I have now taken of him may be considered as an unseasonable digression. The great object of his studies plainly was, to strengthen the old argument for the soul's immateriality, by the new lights furnished by Newton's discoveries.

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on Laughter, although they may not be very highly prized for their depth, bear everywhere the marks of an enlarged and cultivated mind, and, whatever may have been their effects elsewhere, certainly contributed powerfully, in our Northern seats of learning, to introduce a taste for more liberal and elegant pursuits than could have been expected so soon to succeed to the intolerance, bigotry, and barbarism of the preceding century.

[1] See Warburton's *Divine Legation of Moses demonstrated*, p. 395 of the first edition.

[2] Appendix to the first part of the *Inquiry into the Nature of the Human Soul*, pp. 109, 110.

To the intellectual and moral phenomena of Man, and to the laws by which they are regulated, he seems to have paid but little attention.[1]

While Dr Hutcheson's reputation as an author, and still more as an eloquent teacher, was at its zenith in Scotland, Mr Hume began his literary career, by the publication of his *Treatise of Human Nature.* It appeared in 1739, but seems at that time to have attracted little or no attention from the public. According to the author himself, " never literary attempt was more unfortunate. It fell dead-born from the press, without reaching such distinction as even to excite a murmur among the zealots." It forms, however, a very important link in this Historical Sketch, as it has contributed, either directly or indirectly, more than any other single work, to the subsequent progress of the Philosophy of the Human Mind. In order to adapt his principles better to the public taste, the author afterwards threw them into the more popular form of Essays; but it is in the original work that philosophical readers will always study his system, and it is there alone that the relations and bearings of its different parts, as well as its connection with the speculations of his immediate predecessors, can be distinctly traced. It is there, too, that his metaphysical talents appear, in my opinion, to the greatest advantage; nor am I certain that he has anywhere else displayed more skill or a sounder taste in point of composition.[2]

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[1] Baxter was born at Old Aberdeen, in 1686 or 1687, and died at Whittingham, in East Lothian, in 1750. I have not been able to discover the date of the first edition of his *Inquiry into the Nature of the Human Soul,* but the second edition appeared in 1737, two years before the publication of Mr Hume's *Treatise of Human Nature.*

[2] A gentleman, who lived in habits of great intimacy with Dr Reid towards the close of his life, and on whose accuracy I can fully depend, remembers to have heard him say repeatedly, that " Mr Hume, in his *Essays,* appeared to have *forgotten his Metaphysics.*" Nor will this supposition be thought improbable, if, in addition to the subtle and fugitive nature of the subjects canvassed in the *Treatise of Human Nature,* it be considered that long before the publication of his *Essays,* Mr Hume had abandoned all his metaphysical researches. In proof of this, I shall quote a passage from a letter of his to Sir Gilbert Elliot, which, though without a date, seems from its contents to have been written about 1750 or 1751. The passage is interesting on another account, as it serves to show how much Mr Hume undervalued the utility of mathematical learning, and consequently how little he was aware of its importance, as an organ of physical discovery, and as the foundation of some of the most necessary arts of civilized life. " I am sorry that our correspondence should lead us into these abstract speculations. I have thought, and read, and composed very little on such questions of late. Morals, politics, and literature, have employed all my time; but still the other topics I must think more curious, important, entertaining, and useful, than any geometry that is deeper than Euclid."

I have said that it is in Mr Hume's earliest work that his metaphysical talents appear, in my opinion, to the greatest advantage, From the following advertisement, however, prefixed in the latest editions of his works to the second volume of his *Essays* and *Treatises,* Mr Hume himself would appear to have thought differently. " Most of the principles and reasonings contained in this volume were published in a work in three

The great object of Mr. Hume's *Treatise of Human Nature* will be best explained in his own words.

" 'Tis evident that all the sciences have a relation, greater or less, to human nature, and that, however wide any of them may seem to run from it, they still return back by one passage or another. Even Mathematics, Natural Philosophy, and Natural Religion, are in some measure dependent on the science of Man, since they lie under the cognizance of men, and are judged of by their powers and faculties.......... If, therefore, the sciences of Mathematics, Natural Philosophy, and Natural Religion, have such a dependence on the knowledge of man, what may be expected in the other sciences, whose connection with human nature is more close and intimate? The sole end of logic is to explain the principles and operations of our reasoning faculty, and the nature of our ideas: Morals and criticism regard our tastes and sentiments, and politics consider men as united in society, and dependent on each other......... Here, then, is the only expedient from

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volumes, called *A Treatise of Human Nature;* a work which the author had projected before he left College, and which he wrote and published not long after. But not finding it successful, he was sensible of his error in going to the press too early, and he cast the whole anew in the following pieces, where some negligencies in his former reasoning, and some in the expression, are, he hopes, corrected. Yet several writers, who have honoured the author's philosophy with answers, have taken care to direct all their batteries against that juvenile work, which the author never acknowledged, and have affected to triumph in any advantage which they imagined they had obtained over it; a practice very contrary to all rules of candour and fair dealing, and a strong instance of those polemical artifices which a bigoted zeal thinks itself authorised to employ. Henceforth, the author desires, that the following pieces may alone be regarded as containing his philosophical sentiments and principles."

After this declaration, it certainly would be highly uncandid to impute to Mr Hume any philosophical sentiments or principles not to be found in his *Philosophical Essays,* as well as in his *Treatise.* But where is the unfairness of replying to any plausible arguments in the latter work, even although Mr Hume may have omitted them in his subsequent publications; more especially where these arguments supply any useful lights for illustrating his more popular compositions? The *Treatise of Human Nature* will certainly be remembered as long as any of Mr Hume's philosophical writings; nor is any person qualified either to approve or to reject his doctrines, who has not studied them in the systematical form in which they were originally cast. That Mr Hume's remonstrance may be just with respect to some of his adversaries, I believe to be true; but it is surely expressed in a tone more querulous and peevish than is justified by the occasion.

I shall take this opportunity of preserving another judgment of Mr Hume's (still more fully stated) on the merits of this juvenile work. I copy it from a private letter written by himself to Sir Gilbert Elliot, soon after the publication of his *Philosophical Essays.*

" I believe the *Philosophical Essays* contain every thing of consequence relating to the Understanding, which you would meet with in the *Treatise;* and I give you my advice against reading the latter. By shortening and simplifying the questions I really render them more complete. *Addo dum minuo.* The philosophical principles are the same in both; but I was carried away by the heat of youth and invention to publish too precipitately. So vast an undertaking, planned before I was one and twenty, and composed before twenty-five, must necessarily be very defective. I have repented my haste a hundred and a hundred times."

which we can hope for success in our philosophical researches, to leave the tedious lingering method which we have hitherto followed, and, instead of taking now and then a castle or village on the frontier, to march up directly to the capital or centre of these sciences, to human nature itself; which, being once masters of, we may everywhere else hope for an easy victory. From this station we may extend our conquests over all those sciences which more intimately concern human life, and may afterwards proceed at leisure to discover more fully those which are the objects of pure curiosity. There is no question of importance whose decision is not comprised in the Science of Man, and there is none which can be decided with any certainty before we become acquainted with that science. In pretending, therefore, to explain the principles of Human Nature, we, in effect, propose a complete system of the sciences, built on a foundation almost entirely new, and the only one upon which they can stand with any security.

"And, as the science of man is the only solid foundation for the other sciences, so the only solid foundation we can give to this science itself must be laid on experience and observation. 'Tis no astonishing reflection to consider, that the application of experimental philosophy to moral subjects should come after that to natural, at the distance of above a whole century; since we find, in fact, that there was about the same interval betwixt the origin of these sciences; and that, reckoning from Thales to Socrates, the space of time is nearly equal to that betwixt my Lord Bacon and some late philosophers in England,[1] who have begun to put the science of man on a new footing, and have engaged the attention, and excited the curiosity of the public."

I am far from thinking, that the execution of Mr Hume's work corresponded with the magnificent design sketched out in these observations; nor does it appear to me that he had formed to himself a very correct idea of the manner in which the experimental mode of reasoning ought to be applied to moral subjects. He had, however, very great merit in separating entirely his speculations concerning the philosophy of the mind from all physiological hypotheses about the nature of the union between soul and body; and although, from some of his casual expressions, it may be suspected that he conceived our intellectual operations to result from bodily organization,[2] he had yet much too large a share

[1] "Mr Locke, Lord Shaftesbury, Dr Mandeville, Mr Hutcheson, Dr Butler," &c.

[2] The only expression in his works I can recollect at present, that can can give any reasonable countenance to such a suspicion, occurs in his *Posthumous Dialogues*, where he speaks of "that little agitation of the brain which we call thought." (2d Edition, pp. 60, 61.) But no fair inference can be drawn from this, as the expression is put into the mouth of Philo the Sceptic; whereas the author intimates that Cleanthes speaks his own sentiments.

of good sense and sagacity to suppose, that, by studying the latter, it is possible for human ingenuity to throw any light upon the former. His works, accordingly, are perfectly free from those gratuitous and wild conjectures, which a few years afterwards were given to the world with so much confidence by Hartley and Bonnet. And in this respect his example has been of infinite use to his successors in this northern part of the island. Many absurd theories have, indeed, at different times been produced by our countrymen; but I know of no part of Europe where such systems as those of Hartley and Bonnet have been so uniformly treated with the contempt they deserve as in Scotland.[1]

Nor was it in this respect alone, that Mr Hume's juvenile speculations contributed to forward the progress of our national literature. Among the many very exceptionable doctrines involved in them, there are various discussions, equally refined and solid, in which he has happily exemplified the application of metaphysical analysis to questions connected with taste, with the philosophy of jurisprudence, and with the theory of government. Of these discussions some afterwards appeared in a more popular form in his philosophical and literary essays, and still retain a place in the latest editions of his works. but others, not less curious, have been suppressed by the author, probably from an idea, that they were too abstruse to interest the curiosity of ordinary readers. In some of these practical applications of metaphysical principles, we may perceive the germs of several inquiries which have since been successfully prosecuted by Mr Hume's countrymen; and, among others, of those which gave birth to Lord Kames's *Historical Law Tracts*, and to his *Elements of Criticism*.

The publication of Mr Hume's *Treatise* was attended with another important effect in Scotland. He had cultivated the art of writing with much greater success than any of his predecessors, and had formed his taste on the best models of English composition. The influence of his example appears to have been great and general; and was in no instance more remarkable than in the style of his principal antagonists, all of whom, in studying his system, have caught, in no inconsiderable degree, the purity, polish, and precision of his diction. Nobody, I believe, will deny, that Locke himself, considered as an English writer, is far surpassed, not only by Hume, but by Reid, Campbell, Gerard, and Beattie; and of this fact it will not be easy to find a more satisfactory explanation, than in the critical eye with which they were led to canvass a work, equally distinguished by the depth of its reasonings, and by the attractive form in which they are exhibited.

[1] In no part of Mr Hume's metaphysical writings is there the slightest reference to either of these systems, although he survived the date of their publication little less than thirty years.

The fundamental principles from which Mr Hume sets out, differ more in words than in substance from those of his immediate predecessors. According to him, all the objects of our knowledge are divided into two classes, *impressions* and *ideas:* the former, comprehending our *sensations*, properly so called, and also our *perceptions* of sensible qualities (two things betwixt which Mr Hume's system does not lead him to make any distinction); the latter, the objects of our thoughts when we *remember* or *imagine*, or in general exercise any of our intellectual powers on things which are past, absent, or future. These ideas he considers as *copies* of our *impressions*, and the words which denote them as the only *signs* entitled to the attention of a philosopher; every word professing to denote an idea, of which the corresponding impressions cannot be pointed out, being *ipso facto* unmeaning and illusory. The obvious result of these principles is, that what Mr Hume calls *impressions* furnish, either immediately or mediately, the whole materials about which our thoughts can be employed; a conclusion coinciding exactly with the account of the origin of our ideas borrowed by Gassendi from the ancient Epicureans.

With this fundamental principle of the Gassendists, Mr Hume combined the logical method recommended by their great antagonists the Cartesians, and (what seemed still more remote from his Epicurean starting ground) a strong leaning to the idealism of Malebranche and of Berkeley. Like Descartes, he began with doubting of every thing, but he was too quick sighted to be satisfied, like Descartes, with the solutions given by that philosopher of his doubts. On the contrary, he exposes the futility not only of the solutions proposed by Descartes himself, but of those suggested by Locke and others among his successors; ending at last where Descartes began, in considering no one proposition as more certain, or even as more probable than another. That the proofs alleged by Descartes of the existence of the material world are quite inconclusive, had been already remarked by many. Nay, it had been shown by Berkeley and others, that if the principles be admitted on which Descartes, in common with all philosophers, from Aristotle downwards, proceeded, the existence of the material world is impossible. A few bold thinkers, distinguished by the name of Egoists, had gone still farther than this, and had pushed their scepticism to such a length, as to doubt of every thing but their own existence. According to *these*, the proposition *cogito, ergo sum*, is the only truth which can be regarded as absolutely certain. It was reserved for Mr Hume to call in question even this proposition, and to admit only the existence of *impressions* and *ideas*. To dispute against the existence of these he conceived to be impossible, inasmuch as they are the immediate subjects of consciousness. But to admit the existence of the thinking and percipient *I*, was to admit the existence of that imaginary substance called *Mind*, which (according to him)

is no more an object of human knowledge, than the imaginary and exploded substance called *Matter*.

From what has been already said, it may be seen, that we are not to look in Hume's *Treatise* for any regular or connected system. It is neither a scheme of Materialism, nor a scheme of Spiritualism; for his reasonings strike equally at the root of both these theories. His aim is to establish a universal scepticism, and to produce in the reader a complete distrust in his own faculties. For this purpose he avails himself of the data assumed by the most opposite sects, shifting his ground skilfully from one position to another, as best suits the scope of his present argument. With the single exception of Bayle, he has carried this sceptical mode of reasoning farther than any other modern philosopher. Cicero, who himself belonged nominally to the same school, seems to have thought, that the controversial habits imposed on the Academical sect by their profession of universal doubt, required a greater versatility of talent and fertility of invention, than were necessary for defending any particular system of tenets;[1] and it is not improbable, that Mr Hume, in the pride of youthful genius, was misled by this specious but very fallacious idea. On the other hand, Bayle has the candour to acknowledge, that nothing is so easy as to dispute after the manner of the sceptics;[2] and to this proposition every man of reflection will find himself more and more disposed to assent, as he advances in life. It is experience alone that can convince us, how much more difficult it is to make any real progress in the search after truth, than to acquire a talent for plausible disputation.[3]

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[1] "Nam si singulas disciplinas percipere magnum est, quanto majus omnes? quod facere iis necesse est quibus propositum est, veri reperiendi causa, et contra omnes philosophos et pro omnibus dicere.—Cujus rei tantæ tamque difficilis facultatem consecutum esse me non profiteor: Secutum esse præ me fero."—*Cicero de Nat. Deor.* l. i. v.

[2] See the passage quoted from Bayle, in p. 86 of this *Dissertation*.

[3] In the very interesting account, given by Dr Holland, of Velara, a modern Greek physician, whom he met with at Larissa in Thessaly, a few slight particulars are mentioned, which let us completely into the character of that ingenious person. "It appeared (says Dr Holland) that Velara had thought much on the various topics of Metaphysics and Morals, and his conversation on these topic bore the same tone of satirical scepticism which was apparent as the general feature of his opinions. We spoke of the questions of Materialism and Necessity, on both of which he declared an affirmative opinion."—(Holland's *Travels in the Ionian Isles*, &c. p. 275.) "I passed this evening with Velara at his own house, and sat with him till a late hour. During part of the time our conversation turned upon metaphysical topics, and chiefly on the old Pyrrhonic doctrine of the non-existence of Matter. Velara, as usual, took the sceptical side of the argument, in which he showed much ingenuity and great knowledge of the more eminent controversialists on this and other collateral subjects." (*Ibid.* p. 370.) We see here a lively picture of a character daily to be met with in more polished and learned societies, disputing not for truth but for victory; in the first conversation professing himself a Materialist; and in the second denying the existence of Matter; on both occasions, tak-

That this spirit of sceptical argument has been carried to a most pernicious excess in modern Europe, as well as among the ancient Academics, will, I presume, be now very generally allowed; but in the form in which it appears in Mr Hume's *Treatise*, its mischievous tendency has been more than compensated by the importance of those results for which it has prepared the way. The principles which he assumes were sanctioned in common by Gassendi, by Descartes, and by Locke; and from these, in most instances, he reasons with great logical accuracy and force. The conclusions to which he is thus led are often so extravagant and dangerous, that he ought to have regarded them as a proof of the unsoundness of his data; but if he had not the merit of drawing this inference himself, he at least forced it so irresistibly on the observation of his successors, as to be entitled to share with them in the honour of their discoveries. Perhaps, indeed, it may be questioned if the errors which he adopted from his predecessors would not have kept their ground till this day, had not his sagacity displayed so clearly the consequences which they necessarily involve. It is in this sense that we must understand a compliment paid to him by the ablest of his adversaries, when he says, that "Mr Hume's premisês often do more than atone for his conclusions."[1]

The bias of Mr Hume's mind to scepticism seems to have been much encouraged, and the success of his sceptical theories in the same proportion promoted, by the recent attempts of Descartes and his followers to demonstrate Self-evident Truths,—attempts which Mr Hume clearly perceived to involve, in every instance, that sort of paralogism which logicians call *reasoning in a circle*. The weakness of these pretended demonstrations is triumphantly exposed in the *Treatise of Human Nature;* and it is not very wonderful that the author, in the first enthusiasm of his victory over his immediate predecessors, should have fancied that the inconclusiveness of the proofs argued some unsound-

ing up that ground where he was most likely to provoke opposition. If any inference is to be drawn from the conversation of such an individual, with respect to his real creed, it is in favour of those opinions which he controverts. These opinions, at least, we may confidently conclude to be agreeable to the general belief of the country where he lives.

[1] Mr Hume himself (to whom Dr Reid's *Inquiry* was communicated previous to its publication by their common friend Dr Blair) seems not to have been dissatisfied with this apology for some of his speculations. "I shall only say (he observes in a letter addressed to the author), that if you have been able to clear up these abstruse and important subjects, instead of being mortified, I shall be so vain as to pretend to a share of the praise, and shall think that my errors, by having at least some coherence, had led you to make a more strict review of my principles, which were the common ones, and to perceive their futility."—(For the whole of Mr Hume's letter, see *Biographical Memoirs* of Smith, Robertson, and Reid, by the author of this Dissertation, p. 417.)

ness in the propositions which they were employed to support. It would, indeed, have done still greater honour to his sagacity if he had ascribed this to its true cause—the impossibility of confirming, by a process of reasoning, the *fundamental laws of Human belief*; but (as Bacon remarks) it does not often happen to those who labour in the field of science, that the same person who sows the seed should reap the harvest.

From that strong sceptical bias which led this most acute reasoner, on many important questions, to shift his controversial ground according to the humour of the moment, *one* favourable consequence has resulted—that we are indebted to him for the most powerful antidotes we possess against some of the most poisonous errors of modern philosophy. I have already made a similar remark in speaking of the elaborate refutation of Spinozism by Bayle; but the argument stated by Hume, in his *Essay on the Idea of Necessary Connection* (though brought forward by the author with a very different view), forms a still more valuable accession to metaphysical science, as it lays the axe to the very root from which Spinozism springs. The cardinal principle on which the whole of that system turns is, that all events, physical and moral, are *necessarily* linked together as causes and effects; from which principle all the most alarming conclusions adopted by Spinoza follow as unavoidable and manifest corollaries. But, if it be true, as Mr Hume contends, and as most philosophers now admit, that physical causes and effects are known to us merely as *antecedents* and *consequents*; still more, if it be true that the word *necessity*, as employed in this discussion, is altogether unmeaning and insignificant, the whole system of Spinoza is nothing better than a rope of sand, and the very proposition which it professes to demonstrate is incomprehensible by our faculties. Mr Hume's doctrine, in the unqualified form in which he states it, may lead to other consequences not less dangerous; but, if he had not the good fortune to conduct metaphysicians to the truth, he may at least be allowed the merit of having shut up for ever one of the most frequented and fatal paths which led them astray.

In what I have now said, I have supposed my readers to possess that general acquaintance with Mr Hume's *Theory of Causation* which all well-educated persons may be presumed to have acquired. But the close connection of this part of his work with some of the historical details which are immediately to follow, makes it necessary for me, before I proceed farther, to recapitulate a little more particularly some of his most important conclusions.

It was, as far as I know, first shown in a satisfactory manner by Mr Hume, that "every demonstration which has been produced for the necessity of a cause to every new existence is fallacious and sophistical."[1] In illustration of this assertion, he examines three different

[1] *Treatise of Human Nature*, Vol. I. p. 144.—Although Mr Hume, however, succeeded better than any

arguments which have been alleged as proofs of the proposition in question; the first by Mr Hobbes; the second by Dr Clarke; and the third by Mr Locke. And I think it will now be readily acknowledged by every competent judge, that his objections to all these pretended demonstrations are conclusive and unanswerable.

When Mr Hume, however, attempts to show that the proposition in question is not *intuitively* certain, his argument appears to me to amount to nothing more than a logical quibble. Of this one would almost imagine that he was not insensible himself, from the short and slight manner in which he hurries over the discussion. "All certainty (he observes) arises from the comparison of ideas, and from the discovery of such relations as are unalterable, so long as the ideas continue the same. These relations are *resemblance, proportions in quantity and number, degrees of any quality, and contrariety;* none of which are implied in this proposition, *whatever has a beginning has also a cause of existence.* That proposition, therefore, is not intuitively certain. At least, any one who would assert it to be intuitively certain, must deny these to be the only infallible relations, and must find some other relation of that kind to be implied in it, which it will be then time enough to examine."

Upon this passage, it is sufficient for me to observe, that the whole force of the reasoning hinges on two assumptions, which are not only gratuitous, but false. *1st,* That all certainty arises from the comparison of ideas. *2dly,* That *all* the unalterable relations among our ideas are comprehended in his own arbitrary enumeration; *Resemblance, proportions in quantity and numbers, degrees of any quality, and contrariety.* When the correctness of these two premises shall be fully established, it will be time enough (to borrow Mr Hume's own words) to examine the justness of his conclusion.

From this last reasoning, however, of Mr Hume, it may be suspected, that he was aware of the vulnerable point against which his adversaries were most likely to direct their attacks. From the weakness, too, of the entrenchments which he has here thrown up for his own security, he seems to have been sensible, that it was not capable of

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of his predecessors, in calling the attention of philosophers to this discussion, his opinion on the subject does not possess the merit, in point of originality, which was supposed to belong to it either by himself or by his antagonists. See the passages which I have quoted in proof of this, in the first volume of the *Philosophy of the Human Mind,* p. 542, *et seq.* fourth edit. and also in the second volume of the same work, p. 556, *et seq.* second edit. Among these, I request the attention of my readers more particularly to a passage from a book entitled *The Procedure, Extent, and Limits of the Human Understanding,* published two years before the *Treatise of Human Nature,* and commonly ascribed to Dr Browne, Bishop of Cork. The coincidence is truly wonderful, as it can scarcely, by any possibility, be supposed that this book was ever heard of by Mr Hume.

a long or vigorous resistance. In the mean time, he betrays no want of confidence in his original position; but repeating his assertion, that "we derive the opinion of the necessity of a cause to every new production, neither from demonstration nor from intuition," he boldly concludes, that "this opinion must necessarily arise from observation and experience." (Vol. I. p. 147.) Or, as he elsewhere expresses himself; "All our reasonings concerning causes and effects are derived from nothing but custom; and, consequently, belief is more properly an act of the *sensitive* than of the *cogitative* part of our natures." (*Ibid.* p. 321.)

The distinction here alluded to between the *sensitive* and the *cogitative* parts of our nature (it may be proper to remind my readers) makes a great figure in the works of Cudworth and of Kant. By the former it was avowedly borrowed from the philosophy of Plato. To the latter, it is not improbable, that it may have been suggested by this passage in Hume. Without disputing its justness or its importance, I may be permitted to express my doubts of the propriety of stating, so strongly as has frequently been done, the one of these parts of our nature in contrast with the other. Would it not be more philosophical, as well as more pleasing, to contemplate the beautiful harmony between them; and the gradual steps by which the mind is trained by the intimations of the former, for the deliberate conclusions of the latter? If, for example, our conviction of the permanence of the laws of nature be not founded on any process of reasoning (a proposition which Mr Hume seems to have established with demonstrative evidence), but be either the result of an instinctive principle of belief, or of the association of ideas, operating at a period when the light of reason has not yet dawned, what can be more delightful than to find this suggestion of our *sensitive frame*,[1] verified by every step which our reason afterwards makes in the study of physical science; and confirmed with mathematical accuracy by the never-failing accordance of the phenomena of the heavens with the previous calculations of astronomers! Does not this afford a satisfaction to the mind, similar to what it experiences, when we consider the adaptation of the instinct of suction, and of the organs of respiration, to the physical properties of the atmosphere? So far from encouraging scepticism, such a view of human nature seems peculiarly calculated to silence every doubt about the veracity of our faculties.[2]

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[1] Upon either of these suppositions, Mr Hume would, with equal propriety, have referred our anticipation of the future event to the *sensitive part of our nature;* and, in point of fact, the one supposition would have answered his purpose as well as the other.

[2] It is but justice to Mr Hume to remark, that, in his later publications, he has himself suggested this very idea as the best solution he could give of his own doubts. The following passage, which appears to me to

It is not my business at present to inquire into the soundness of Mr. Hume's doctrines on this subject. The rashness of some of them has, in my opinion, been sufficiently shown by more than one of his antagonists. I wish only to remark the important step which he made, in exposing the futility of the reasonings by which Hobbes, Clarke, and Locke, had attempted to demonstrate the metaphysical axiom, that "every thing which begins to exist must have a cause;" and the essential service which he rendered to true philosophy, by thus pointing out indirectly to his successors, the only solid ground on which that principle is to be defended. It is to this argument of Hume's, according to Kant's own acknowledgment, that we owe the *Critique of Pure Reason;* and to this we are also indebted for the far more luminous refutations of scepticism by Mr. Hume's own countrymen.

In the course of Mr Hume's very refined discussions on this subject, he is led to apply

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be eminently philosophical and beautiful, I beg leave to recommend to the particular attention of Kant's disciples:

"Here, then, is a kind of pre-established harmony between the course of nature and the succession of our ideas; and though the powers and forces by which the former is governed be wholly unknown to us, yet our thoughts and conceptions have still, we find, gone on in the same train with the other works of nature. Custom is that principle by which this correspondence has been effected; so necessary to the subsistence of our species, and the regulation of our conduct in every circumstance and occurrence of human life. Had not the presence of an object instantly excited the idea of those objects commonly conjoined with it, all our knowledge must have been limited to the narrow sphere of our memory and senses; and we should never have been able to adjust means to ends, or employ our natural powers, either to the producing of good, or avoiding of evil. Those who delight in the discovery and contemplation of *final causes* have here ample subject to employ their wonder and admiration.

"I shall add, for a further confirmation of the foregoing theory, that, as this operation of the mind, by which we infer like effects from like causes, and *vice versa,* is so essential to the subsistence of all human creatures, it is not probable that it could be trusted to the fallacious deductions of our reason, which is slow in its operations, appears not in any degree, during the first years of infancy; and at best is, in every age and period of human life, extremely liable to error and mistake. It is more conformable to the ORDINARY WISDOM OF NATURE to secure so necessary an act of the mind by some instinct or mechanical tendency which may be infallible in its operations, may discover itself at the first appearance of life and thought, and may be independent of all the laboured deductions of the understanding. As nature has taught us the use of our limbs, without giving us the knowledge of the muscles and nerves by which they are actuated, so has she implanted in us an instinct which carries forward the thoughts in a correspondent course to that which she has established among external objects; though we are ignorant of those powers and forces on which this regular course and succession of objects totally depends." (See, in the last editions of Mr Hume's *Philosophical Essays,* published during his own lifetime, the two sections entitled *Sceptical Doubts concerning the Operations of the Understanding;* and *Sceptical Solution of these Doubts.* The title of the latter of these sections has, not altogether without reason, incurred the ridicule of Dr Beattie, who translates it, *Doubtful Solution of Doubtful Doubts.* But the essay contains much sound and important matter, and throws a strong light on some of the chief difficulties which Mr Hume himself had started. Sufficient justice has not been done to it by his antagonists.)

them to one of the most important principles of the mind,—our belief of the continuance of the laws of nature; or, in other words, our belief that the future course of nature will resemble the past. And here, too (as I already hinted), it is very generally admitted, that he has succeeded completely in overturning all the theories which profess to account for this belief by resolving it into a process of reasoning.[1] The only difference which seems to remain among philosophers is, whether it can be explained, as Mr Hume imagined, by means of the association of ideas; or, whether it must be considered as an original and fundamental law of the human understanding,—a question, undoubtedly abundantly curious, as a problem connected with the *Theory of the Mind*; but to which more practical importance has sometimes been attached than I conceive to be necessary.[2]

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[1] The incidental reference made, by way of illustration, in the following passage, to our *instinctive conviction of the permanency* of the laws of Nature, encourages me to hope, that, among candid and intelligent inquirers, it is now received as an acknowledged fact in the Theory of the Human Mind.

" The anxiety men have in all ages shown to obtain a fixed standard of value, and that remarkable agreement of nations, dissimilar in all other customs, in the use of one medium, on account of its superior fitness for that purpose, is itself a convincing proof how essential it is to our social interests. The notion of its premanency, although it be conventional and arbitrary, and liable, in reality, to many causes of variation, yet had gained so firm a hold on the minds of men, as to resemble, in its effects on their conduct, that *instinctive conviction of the permanency of the laws of nature which is the foundation of all our reasoning*." (*A Letter to the Right Hon. R. Peel, M. P. for the University of Oxford*, by one of his Constituents. Second edition, p. 23.)

[2] The difference between the two opinions amounts to nothing more than this, whether our expectation of the continuance of the laws of nature results from a principle coëval with the first exercise of the senses; or whether it arises gradually from the accommodation of the order of our thoughts to the established order of physical events. " Nature (as Mr Hume himself observes) *may* certainly produce whatever can arise from habit; nay, habit is nothing but one of the principles of nature, and derives all its force from that origin." (*Treatise of Human Nature*, Vol. I. p. 313.) Whatever ideas, therefore, and whatever principles we are unavoidably led to acquire by the circumstances in which we are placed, and by the exercise of those faculties which are essential to our preservation, are to be considered as parts of human nature no less than those which are implanted in the mind at its first formation. Are not the acquired perceptions of sight and of hearing as much parts of human nature as the original perceptions of external objects which we obtain by the use of the hand?

The passage quoted from Mr Hume, in Note 2, p. 180, if attentively considered, will be found, when combined with these remarks, to throw a strong and pleasing light on his latest views with respect to this part of his philosophy.

In denying that our expectation of the continuance of the laws of nature is founded on reasoning, as well as in asserting our ignorance of any necessary connections among physical events, Mr Hume had been completely anticipated by some of his predecessors. (See the references mentioned in the Note, p. 178.) I do not, however, think that, before his time, philosophers were at all aware of the alarming consequences which, on a superficial view, *seem* to follow from this part of his system. Indeed, these consequences would never have been apprehended, had it not been supposed to form an essential link in his argument against the commonly received notion of Causation.

That Mr Hume himself conceived his refutation of the theories which profess to assign its reason for our faith in the permanence of the laws of nature, to be closely connected with his sceptical conclusions concerning *causation*, is quite evident from the general strain of his argument; and it is, therefore, not surprising that this refutation should have been looked on with a suspicious eye by his antagonists. Dr Reid was, I believe, the first of these who had the sagacity to perceive, not only that it is strictly and inconvertibly logical, but that it may be safely admitted, without any injury to the doctrines which it was brought forward to subvert.

Another of Mr Hume's attacks on these doctrines was still bolder and more direct. In conducting it he took his vantage ground from his own account of the origin of our ideas. In this way he was led to expunge from his Philosophical Vocabulary every word of which the meaning cannot be explained by reference to the *impression* from which the corresponding *idea* was originally copied. Nor was he startled in the application of this rule, by the consideration, that it would force him to condemn, as insignificant, many words which are to be found in all languages, and some of which express what are commonly regarded as the most important objects of human knowledge. Of this number are the words *cause* and *effect;* at least, in the sense in which they are commonly understood both by the vulgar and by philosophers. "One event (says he) *follows another, but* we never observe any tie between them. They seem *conjoined*, but never *connected*. And as we can have no idea of any thing which never appeared to our outward sense or inward sentiment, the necessary conclusion seems to be, that we have no idea of connection or power at all; and that these words are absolutely without any meaning, when employed either in philosophical reasonings or common life." (Hume's *Essays*, Vol. II. p. 79. Ed. of Lond. 1784.)

When this doctrine was first proposed by Mr Hume, he appears to have been very strongly impressed with its repugnance to the common apprehensions of mankind. "I am sensible (he observes) that of all the paradoxes which I have had, or shall hereafter have occasion to advance in the course of this treatise, the present one is the most violent." (*Treatise of Human Nature*, Vol. I. p. 291.) It was probably owing to this impression that he did not fully unfold in that work all the consequences which, in his subsequent publications, he deduced from the same paradox; nor did he even apply it to invalidate the argument which infers the existence of an *intelligent* cause from the order of the universe. There cannot, however, be a doubt that he was aware, at this period of his life, of the conclusions to which it unavoidably leads, and which are indeed too obvious to escape the notice of a far less acute inquirer.

In a private letter of Mr Hume's to one of his most intimate friends,[1] some light is thrown on the circumstances which first led his mind into this train of sceptical speculation. As his narrative has every appearance of the most perfect truth and candour, and contains several passages which I doubt not will be very generally interesting to my readers, I shall give it a place, together with some extracts from the correspondence to which it gave rise, in the Notes at the end of this *Dissertation*. Every thing connected with the origin and composition of a work which has had so powerful an influence on the direction which metaphysical pursuits have since taken, both in Scotland[2] and in Germany, will be allowed to form an important article of philosophical history; and this history I need not offer any apology for choosing to communicate to the public rather in Mr Hume's words than in my own.[3]

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[1] Sir Gilbert Elliot, Bart. grandfather of the present Earl of Minto. The originals of the letters to which I refer are in Lord Minto's possession.

[2] A foreign writer, of great name (M. Frederick Schlegel), seems to think that the influence of Mr Hume. *Treatise of Human Nature* on the Philosophy of England has been still more extensive than I had conceived it to be. His opinion on this point I transcribe as a sort of literary curiosity.

"Since the time of Hume, nothing more has been attempted in England, than to erect all sorts of bulwarks against the practical influence of his destructive scepticism; and to maintain, by various substitutes and aids, the pile of moral principle uncorrupted and entire. *Not only with Adam Smith, but with all their late philosophers, national welfare is the ruling and central principle of thought;—a principle excellent and praiseworthy in its due situation, but quite unfitted for being the centre and oracle of all knowledge and science.*" From the connection in which this last sentence stands with the context, would not one imagine that the writer conceived the *Wealth of Nations* to be a new *moral* or *metaphysical* system, devised by Mr Smith, for the purpose of counteracting Mr Hume's scepticism?

I have read this translation of Mr Schlegel's lectures with much curiosity and interest, and flatter myself that we shall soon have English versions of the works of Kant, and of other German authors, from the pens of their English disciples. Little more, I am fully persuaded, is necessary, in this country, to bring down the philosophy of Germany to its proper level.

In treating of literary and historical subjects, Mr Schlegel seems to be more in his element, than when he ventures to pronounce on philosophical questions. But even in cases of the former description, some of his dashing judgments on English writers can be accounted for only by haste, caprice, or prejudice. "The English themselves (we are told) are now pretty well convinced, that Robertson is a careless, superficial, and blundering historian: although they study his works, and are right in doing so, as models of pure composition, extremely deserving of attention during the present declining state of English style. . . . . With all the abundance of his Italian elegance, what is the overloaded and affected Roscoe when compared with Gibbon? Coxe, although master of a good and classical style, resembles Robertson in no respect so much as in the superficialness of his researches; and the statesman Fox has nothing in common with Hume but the bigotry of his party zeal." Such criticisms may perhaps be applauded by a German auditory, but in this country they can injure the reputation of none but their author.

[3] See Note (II.)

From the reply to this letter by Mr Hume's very ingenious and accomplished correspondent, we learn that he had drawn from Mr Hume's metaphysical discussions the only sound and philosophical inference: that the lameness of the proofs offered by Descartes and his successors, of some fundamental truths universally acknowledged by mankind, proceeded, not from any defect in the evidence of these truths, but, on the contrary, from their being *self-evident*, and consequently unsusceptible of demonstration. We learn, farther, that the same conclusion had been adopted, at this early period, by another of Mr Hume's friends, Mr Henry Home, who, under the name of Lord Kames, was afterwards so well known in the learned world. Those who are acquainted with the subsequent publications of this distinguished and most respectable author will immediately recognize, in the account here given of the impression left on his mind by Mr Hume's scepticism, the rudiments of a peculiar logic, which runs more or less through all his later works; and which, it must be acknowledged, he has, in various instances, carried to an unphilosophical extreme.[1]

The light in which Mr Hume's scepticism appears from these extracts to have struck his friends, Sir Gilbert Elliot and Lord Kames, was very nearly the same with that in which it was afterwards viewed by Reid, Oswald, and Beattie, all of whom have manifestly aimed, with greater or less precision, at the same logical doctrine which I have just alluded to. This, too, was the very ground on which Father Buffier had (even before the publication of the *Treatise of Human Nature*) made his stand against similar theories, built by his predecessors on the Cartesian principles. The coincidence between his train of thinking, and that into which our Scottish metaphysicians soon after fell is so very remarkable, that it has been considered by many as amounting to a proof that the plan of their works was, in some measure, suggested by his; but it is infinitely more probable, that the argument which runs, in common, through the speculations of all of them, was the natural result of the state of metaphysical science when they engaged in their philosophical inquiries.[2]

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[1] I allude particularly to the unnecessary multiplication, in his philosophical arguments, of internal senses and of instinctive principles.

[2] Voltaire, in his catalogue of the illustrious writers who adorned the reign of Louis XIV. is one of the very few French authors who have spoken of Buffier with due respect: "Il y a dans ses traités de métaphysique des morceaux que Locke n'aurait pas désavoués, et c'est le seul jésuite qui ait mis une philosophie raisonnable dans ses ouvrages." Another French philosopher, too, of a very different school, and certainly not disposed to overrate the talents of Buffier, has, in a work published as lately as 1805, candidly acknowledged the lights which he might have derived from the labours of his predecessor, if he had been acquainted with them at

The answer which Mr Hume made to this argument, when it was first proposed to him in the easy intercourse of private correspondence, seems to me an object of so much curiosity, as to justify me for bringing it under the eye of my readers in immediate connection with the foregoing details. Opinions thus communicated in the confidence of friendly discussion, possess a value which seldom belongs to propositions hazarded in those public controversies where the love of victory is apt to mingle, more or less, in the most candid minds, with the love of truth.

" Your notion of correcting subtilty by *sentiment* is certainly very just with regard to morals, which depend upon sentiment: And in politics and natural philosophy, whatever conclusion is contrary to certain matters of fact, must certainly be wrong, and there must some error lie somewhere in the argument, whether we be able to show it or not. But, in metaphysics or theology, I cannot see how either of these plain and obvious standards of truth can have place. Nothing there can correct bad reasoning but good reasoning; and sophistry must be opposed by syllogism.[1] About seventy or eighty years ago,[2] I observe a principle like that which you advance prevailed very much in France, amongst some philosophers and beaux esprits. The occasion of it was this: The famous M. Nicole of the Port Royal, in his *Perpetuité de la Foi*, pushed the Protestants very hard upon the impossibility of the people's reaching a conviction of their religion by the way of private judgment, which required so many disquisitions, reasonings, researches, erudition, impartiality, and penetration, as not one of a hundred, even among men of education, is capable of. M. Claude and the Protestants answered him, not by solving his difficulties (which seems impossible), but by retorting them (which is very easy). They showed, that to reach the way of authority which the Catholics insist on, as long a train of acute reasoning, and as great erudition was requisite, as would be sufficient for a Protestant. We must first prove all the truths of natural religion, the foundation of morals, the divine

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an earlier period of his studies. Condillac, he also observes, might have profited greatly by the same lights, if he had availed himself of their guidance, in his inquiries concerning the human understanding. " Dumoins est il certain que pour ma part, je suis fort faché de ne connôitre que depuis très peu de temps ces opinions du Pere Buffier; si je les avais vues plutot énoncées quelque part, elles m'auraient épargné beaucoup de peines et d'hésitations."—" Je regrette beaucoup que Condillac, dans ses profondes et sagaces méditations sur l'intelligence humaine, n'ait pas fait plus d'attention aux idées du Père Buffier," &c. &c.—*Elémens d'Idéologie*, par M. Destutt-Tracy, Tom. III. pp. 136, 137. (See *Elements of the Philosophy of the Human Mind*, Vol. II. pp. 88, 89, 2d edit.)

[1] May not sophistry be also opposed, by appealing to the *fundamental laws of human belief*; and, in some cases, by appealing to *facts* for which we have the evidence of our own consciousness? The word *sentiment* does not express, with sufficient precision, the test which Mr Hume's correspondent had manifestly in view.

[2] This letter is dated 1751.

authority of the scripture, the deference which it commands to the church, the tradition of the church, &c. &c. The comparison of these controversial writings begat an idea in some, that it was neither by reasoning nor authority we learn our religion, but by sentiment; and this was certainly a very convenient way, and what a philosopher would be very well pleased to comply with, if he could distinguish sentiment from education. But, to all appearance, the sentiment of Stockholm, Geneva, Rome, ancient and modern, Athens, and Memphis, have the same characters; and no thinking man can implicitly assent to any of them, but from the general principle, that, as the truth on these subjects is beyond human capacity, and that, as for one's own case, he must adopt some tenets, there is more satisfaction and convenience in holding to the catechism we have been first taught. Now, this I have nothing to say against. I would only observe, that such a conduct is founded on the most universal and determined scepticism. For more curiosity and research give a direct opposite turn from the same principles."

On this careless effusion of Mr Hume's pen, it would be unpardonable to offer any critical strictures. It cannot, however, be considered as improper to hint, that there is a wide and essential difference between those articles of faith, which formed the subjects of dispute between Nicole and Claude, and those *laws of belief*, of which it is the great object of the *Treatise of Human Nature* to undermine the authority. The reply of Mr Hume, therefore, is evasive, and although strongly marked with the writer's ingenuity, does not bear upon the point in question.

As to the distinction alleged by Mr Hume between the *criteria* of truth in natural philosophy and in metaphysics, I trust it will now be pretty generally granted, that, however well founded it may be when confined to the metaphysics of the schoolmen, it will by no means hold when extended to the inductive philosophy of the human mind. In this last science, no less than in natural philosophy, Mr Hume's logical maxim may be laid down as a fundamental principle, that " whatever conclusion is contrary to matter of fact must be wrong, and there must some error lie somewhere in the argument, whether we be able to show it or not."

It is a remarkable circumstance in the history of Mr Hume's literary life, and a proof of the sincerity with which he was then engaged in the search of truth, that, previous to the publication of his *Treatise of Human Nature*, he discovered a strong anxiety to submit it to the examination of the celebrated Dr Butler, author of the *Analogy of Religion, Natural and Revealed, to the Constitution and Course of Nature.* For this purpose he applied to Mr Henry Home, between whom and Dr Butler some friendly letters appear to have passed before this period. " Your thoughts and mine (says Mr Hume to his

correspondent) agree with respect to Dr Butler, and I would be glad to be introduced to him. I am at present castrating my work, that is, cutting off its nobler parts; that is, endeavouring it shall give as little offence as possible, before which I could not pretend to put it into the doctor's hands."[1] In another letter, he acknowledges Mr Home's kindness in recommending him to Dr Butler's notice. "I shall not trouble you with any formal compliments or thanks, which would be but an ill return for the kindness you have done me in writing in my behalf, to one you are so little acquainted with as Dr Butler; and, I am afraid, stretching the truth in favour of a friend. I have called on the doctor, with a design of delivering your letter, but find he is at present in the country. I am a little anxious to have the doctor's opinion. My own I dare not trust to; both because it concerns myself, and because it is so variable, that I know not how to fix it. Sometimes it elevates me above the clouds; at other times it depresses me with doubts and fears; so that, whatever be my success, I cannot be entirely disappointed."

Whether Mr Hume ever enjoyed the satisfaction of a personal interview with Dr Butler, I have not heard. From a letter of his to Mr Home, dated London, 1739, we learn, that if any intercourse took place between them, it must have been after the publication of the *Treatise of Human Nature*. "I have sent the Bishop of Bristol a copy; but could *not wait upon him with* your letter after he had arrived at that dignity. At least I thought it would be to no purpose after I began the printing."[2] In a subsequent letter to the same correspondent, written in 1742, he expresses his satisfaction at the favourable opinion which he understood Dr Butler had formed of his volume of *Essays*, then recently published, and augurs well from this circumstance of the success of his book. "I am told that Dr Butler has every where recommended them, so that I hope they will have some success."[3]

These particulars, trifling as they may appear to some, seemed to me, for more reasons than one, not unworthy of notice in this sketch. Independently of the pleasing record they afford of the mutual respect entertained by the eminent men to whom they relate, for each other's philosophical talents, they have a closer connection with the history of metaphysical and moral inquiry in this island, than might be suspected by those who have not

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[1] For the rest of the letter, see *Memoirs of the Life and Writings of Lord Kames*, by Lord Woodhouselee, Vol. I. p. 84, *et seq.*

[2] *Memoirs of the Life and Writings of Lord Kames*, Vol. I. p. 92.

[3] *Ibid.* p. 404. The *Essays* here referred to were the first part of the Essays Moral, Political, and Literary, published in 1742. The elegant author of these memoirs has inadvertently confounded this volume with the second part of that work, containing the *Political Discourses* (properly so called), which did not appear till ten years afterwards.

a very intimate acquaintance with the writings of both. Dr Butler was, I think, the first of Mr Locke's successors who clearly perceived the dangerous consequences likely to be deduced from his account of the origin of our ideas literally interpreted; and although he has touched on this subject but once, and that with his usual brevity, he has yet said enough to show, that his opinion with respect to it was the same with that formerly contended for by Cudworth, in opposition to Gassendi and Hobbes, and which has since been revived in different forms by the ablest of Mr Hume's antagonists.[1] With these views, it may be reasonably supposed, that he was not displeased to see the consequences of Locke's doctrine so very logically and forcibly pushed to their utmost limits, as the most effectual means of rousing the attention of the learned to a re-examination of this fundamental principle. That he was perfectly aware, before the publication of Mr Hume's work, of the encouragement given to scepticism by the logical maxims then in vogue, is evident from the concluding paragraph of his short *Essay on Personal Identity*. Had it been published a few years later, nobody would have doubted, that it had been directly pointed at the general strain and spirit of Mr Hume's philosophy.

"But though we are thus certain, that we are the same agents or living beings *now*, which we were as far back as our remembrance reaches; yet it is asked, Whether we may not possibly be deceived in it? And this question may be asked at the end of any demonstration whatever, because it is a question concerning the truth of perception by memory. And he who can doubt, whether perception by memory can in this case be depended on, may doubt also whether perception by deduction and reasoning, which also includes memory, or indeed whether intuitive perception can. Here then we can go no farther. For it is ridiculous to attempt to prove the truth of those perceptions whose truth we can no otherwise prove than by other perceptions of exactly the same kind with them, and which there is just the same ground to suspect; or to attempt to prove the truth of our faculties, which can no otherwise be proved, than by the use or means of those very suspected faculties themselves."[2]

It is, however, less as a speculative metaphysician, than as a philosophical inquirer into

[1] See the short *Essay on Personal Identity*, at the end of Butler's *Analogy*; and compare the second paragraph with the remarks on this part of Locke's *Essay* by Dr Price. (*Review of the Principal Questions and Difficulties relating to Morals*, pp. 49, 50. 3d Ed. Lond. 1787.)

[2] I must not, however, be understood as giving unqualified praise to this Essay. It is by no means free from the old scholastic jargon, and contains some reasoning which, I may confidently assert, the author would not have employed, had it been written fifty years later. Whoever takes the trouble to read the paragraph beginning with these words, "*Thirdly*, Every person is conscious," &c. will immediately perceive the truth of this remark. I mention it as a proof of the change to the better, which has taken place since Butler's time, in the mode of thinking and writing on Metaphysical questions.

the principles of morals, that I have been induced to associate the name of Butler with that of Hume. And, on this account, it may be thought that it would have been better to delay what I have now said of him till I come to trace the progress of Ethical Science during the eighteenth century. To myself it seemed more natural and interesting to connect this historical or rather biographical digression, with the earliest notice I was to take of Mr Hume as an author. The numerous and important hints on metaphysical questions which are scattered over Butler's works, are sufficient of themselves to account for the space I have allotted to him among Locke's successors; if, indeed, any apology for this be necessary, after what I have already mentioned, of Mr Hume's ambition to submit to his judgment the first fruits of his metaphysical studies.

The remarks hitherto made on the *Treatise of Human Nature* are confined entirely to the first volume. The speculations contained in the two others, on Morals, on the Nature and Foundations of Government, and on some other topics connected with political philosophy, will fall under our review afterwards.

Dr Reid's *Inquiry into the Human Mind* (published in 1764) was the first direct attack which appeared in Scotland upon the sceptical conclusions of Mr Hume's philosophy. For my own opinion of this work I must refer to one of my former publications.[1] It is enough to remark here, that its great object is to refute the *Ideal Theory* which was then in complete possession of the schools, and upon which Dr Reid conceived that the whole of Mr Hume's philosophy, as well as the whole of Berkeley's reasonings against the existence of matter, was founded. According to this theory we are taught, that "nothing is perceived but what is in the mind which perceives it; that we do not really perceive things that are external, but only certain images and pictures of them imprinted upon the mind, which are called impressions and ideas."—"This doctrine (says Dr Reid on another occasion) I once believed so firmly, as to embrace the whole of Berkeley's system along with it; till finding other consequences to follow from it, which gave me more uneasiness than the want of a material world, it came into my mind, more than forty years ago, to put the question, What evidence have I for this doctrine, that all the objects of my knowledge are ideas in my own mind? From that time to the present, I have been candidly and impartially, as I think, seeking for the evidence of this principle; but can find none, excepting the authority of philosophers."

On the refutation of the ideal theory, contained in this and his other works, Dr Reid himself was disposed to rest his chief merit as an author. "The merit (says he in a letter

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[1] See *Biographical Memoirs*, Edin. 1811.

to Dr James Gregory) of what you are pleased to call *my Philosophy*, lies, I think, chiefly in having called in question the common theory of ideas or images of things in the mind being the only objects of thought; a theory founded on natural prejudices, and so universally received as to be interwoven with the structure of language. Yet were I to give you a detail of what led me to call in question this theory, after I had long held it as self-evident and unquestionable, you would think, as I do, that there was much of chance in the matter. The discovery was the birth of time, not of genius; and Berkeley and Hume did more to bring it to light than the man that hit upon it. I think there is hardly any thing that can be called *mine* in the philosophy of the mind, which does not follow with ease from the detection of this prejudice.

"I must, therefore, beg of you, most earnestly, to make no contrast in my favour to the disparagement of my predecessors in the same pursuits. I can truly say of them, and shall always avow, what you are pleased to say of me, that, but for the assistance I have received from their writings, I never could have wrote or thought what I have done."[1]

When I reflect on the stress thus laid by Dr Reid on this part of his writings, and his frequent recurrence to the same argument whenever his subject affords him an opportunity of forcing it upon the attention of his readers, I cannot help expressing my wonder, that Kant and other German philosophers, who appear to have so carefully studied those passages in Reid, which relate to Hume's Theory of Causation, should have overlooked en-

[1] An ingenious and profound writer, who, though intimately connected with Mr Hume in habits of friendship, was not blind to the vulnerable parts of his Metaphysical System, has bestowed, in the latest of his publications, the following encomium on Dr Reid's *Philosophical Works*.

"The author of an *Inquiry into the Mind*, and of subsequent *Essays on the Intellectual and Active Powers of Man*, has great merit in the effect to which he has pursued this history. But, considering the point at which the science stood when he began his inquiries, he has, perhaps, no less merit in having removed the mist of hypothesis and metaphor, with which the subject was enveloped; and, in having taught us to state the facts of which we are conscious, not in figurative language, but in the terms which are proper to the subject. In this it will be our advantage to follow him; the more that, in former theories, so much attention had been paid to the introduction of *ideas* or *images* as the elements of knowledge, that the belief of any external existence or prototype has been left to be inferred from the mere idea or image; and this inference, indeed, is so little founded, that many who have come to examine its evidence have thought themselves warranted to deny it altogether. And hence the scepticism of ingenious men, who, not seeing a proper access to knowledge through the medium of ideas, without considering whether the road they had been directed to take was the true or false one, denied the possibility of arriving at the end." (*Principles of Moral and Political Science*, by Dr Adam Ferguson, Vol. I. pp. 75, 76.)

The work from which this passage is taken contains various important observations connected with the Philosophy of the Human Mind; but as the taste of the author led him much more strongly to moral and political speculations, than to researches concerning the intellectual powers of man, I have thought it right to reserve any remarks which I have to offer on his philosophical merits for the last part of this Discourse.

tirely what he himself considered as the most original and important of all his discussions; more especially as the conclusion to which it leads has been long admitted, by the best judges in this island, as one of the few propositions in metaphysical science completely established beyond the reach of controversy. Even those who affect to speak the most lightly of Dr Reid's contributions to the philosophy of the human mind, have found nothing to object to his reasonings against the ideal theory, but that the absurdities involved in it are too glaring to require a serious examination.[1] Had these reasonings been considered in the same light in Germany, it is quite impossible that the analogical language of Leibnitz, in which he speaks of the soul as *a living mirror of the universe*, could have been again revived; a mode of speaking liable to every objection which Reid has urged against the ideal theory. Such, however, it would appear, is the fact. The word *Representation (Vorstellung)* is now the German substitute for *Idea*: nay, one of the most able works which Germany has produced since the commencement of its new philosophical era, is entitled *Nova Theoria Facultatis Repræsentativæ Humanæ.* In the same work, the author has prefixed, as a motto to the second book, in which he treats of "the *Representative Faculty* in general," the following sentence from Locke, which he seems to have thought himself entitled to assume as a first principle: "Since the mind, in

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[1] I allude here more particularly to Dr Priestley, who, in a work published in 1774, alleged, that when philosophers called ideas the *images* of external things, they are only to be understood as speaking figuratively; and that Dr Reid has gravely argued against this metaphorical language, as if it were meant to convey a theory of perception. The same remark has been repeated over and over since Priestley's time, by various writers. I have nothing to add in reply to it to what I long ago stated in my Philosophical Essays (see Note H. at the end of that work), but the following short quotation from Mr Hume:—

"It seems evident, that, when men follow this blind and powerful instinct of nature, they always suppose the very images, presented by the senses, to be the external objects, and never entertain any suspicion, that the one are nothing but *representations* of the other. * * * * But this universal and primary opinion of all men is soon destroyed by the slightest philosophy, which teaches us, that nothing can ever be present to the mind but an *image* or perception, and that the senses are only the inlets through which these images are conveyed, without being able to produce any immediate intercourse between the mind and the object. The table which we see seems to diminish as we remove farther from it; but the real table, which exists independent of us, suffers no alteration. It was, therefore, nothing but its image which was present to the mind. These are the obvious dictates of reason." (*Essay on the Academical Philosophy.*)

Is not this analogical theory of perception the principle on which the whole of Berkeley's reasonings against the existence of the material world, and of Hume's scepticism on the same subject, are founded?

The same analogy still continues to be sanctioned by some English philosophers of no small note. Long after the publication of Dr Reid's *Inquiry*, Mr Horne Took quoted with approbation the following words of J. C. Scaliger: "Sicut in speculo ea quæ videntur non sunt, sed eorum *species*: ita quæ intelligimus, ea sunt re ipsâ extra nos, eorumque *species* in nobis. EST ENIM QUASI RERUM SPECULUM INTELLECTUS NOSTER; CUI, NISI PER SENSUM REPRESENTENTUR RES, NIHIL SCIT IPSE."—(J. C. Scaliger, *de Causis*, L. I. cap. lxvi.) *Diversions of Purley*, Vol. I. p. 35, 2d Edition.)

all its thoughts and reasonings, hath no other *immediate* object but its own *ideas (representations)*, which it alone does or can contemplate, it is evident that our knowledge is only conversant about them."—(Lock's *Essay*, B. IV. ch. 1.) In a country where this metaphysical jargon still passes current among writers of eminence, it is vain to expect that any solid progress can be made in the inductive philosophy of the human mind. A similar remark may be extended to another country, where the title of *Idéologie* (a word which takes for granted the truth of the hypothesis which it was Reid's great aim to explode) has been lately given to the very science in which the theory of *Ideas* has been so clearly shown to have been, in all ages, the most fruitful source of error and absurdity.[1]

Of the other works by Scottish metaphysicians, which appeared soon after the *Inquiry into the Human Mind*, I have not left myself room to speak. I know of none of them from which something important may not be learned; while several of them (particularly those of Dr Campbell) have struck out many new and interesting views. To one encomium all of them are well entitled, that of aiming steadily at the advancement of useful knowledge and of human happiness. But the principles on which they have proceeded have so close an affinity to those of Dr Reid, that I could not, without repeating over what I have already said, enter into any explanation concerning their characteristical doctrines.

On comparing the opposition which Mr Hume's scepticism encountered from his own countrymen, with the account formerly given of the attempts of some German philosophers to refute his Theory of Causation, it is impossible not to be struck with the coincidence between the leading views of his most eminent antagonists. This coincidence one would have been disposed to consider as purely accidental, if Kant, by his petulant sneers at Reid, Beattie, and Oswald, had not expressly acknowledged, that he was not acquainted with their writings. As for the great discovery, which he seems to claim as his own,—that the ideas of Cause and Effect, as well as many others, are derived from the *pure understanding* without any aid from experience, it is nothing more than a repetition, in very nearly the same terms, of what was advanced a century before by Cudworth, in reply to Hobbes and Gassendi; and borrowed avowedly by Cudworth from the reasonings of Socrates, as reported by Plato, in answer to the scepticism of Protagoras. This recur-

[1] In censuring these metaphorical terms, I am far from supposing that the learned writers who have employed them have been all misled by the theoretical opinions involved in their language. Reinhold has been more particularly careful in guarding against such a misapprehension. But it cannot, I think, be doubted that the prevalence of such a phraseology must have a tendency to divert the attention from a just view of the mental phenomena, and to infuse into the mind of the young inquirer very false conceptions of the manner in which these phenomena ought to be studied.

rence, under different forms, of the same metaphysical controversies, which so often surprises and mortifies us in the history of literature, is an evil which will probably always continue, more or less, even in the most prosperous state of philosophy. But it affords no objection to the utility of metaphysical pursuits. While the sceptics keep the field, it must not be abandoned by the friends of sounder principles; nor ought they to be discouraged from their ungrateful task, by the reflection, that they have probably been anticipated, in every thing they have to say, by more than one of their predecessors. If anything is likely to check this periodical return of a mischief so unpropitious to the progress of useful knowledge, it seems to be the general diffusion of that historical information concerning the literature and science of former times, of which it is the aim of these Preliminary Dissertations to present an outline. Should it fail in preventing the occasional revival of obsolete paradoxes, it will, at least, diminish the wonder and admiration with which they are apt to be regarded by the multitude.

And here I cannot refrain from remarking the injustice with which the advocates for truth are apt to be treated; and by none more remarkably than by that class of writers who profess the greatest zeal for its triumph. The importance of their labours is discredited by those who are the loudest in their declamations and invectives against the licentious *philosophy of the present age*; insomuch that a careless observer would be inclined to imagine (if I may borrow Mr Hume's words on another occasion), that the battle was fought, "not by the men at arms, who manage the pike and the sword, but by the trumpeters, drummers, and musicians, of the army."

These observations may serve, at the same time, to account for the slow and (according to some persons) imperceptible advances of the philosophy of the human mind, since the publication of Locke's *Essay*. With those who still attach themselves to that author, as an infallible guide in metaphysics, it is in vain to argue; but I would willingly appeal to any of Locke's rational and discriminating admirers, whether much has not been done by his successors, and, among others, by members of our northern universities, towards the illustration and correction of such of his principles as have furnished, both to English and French sceptics, the foundation of their theories.[1] If this be granted, the way has, at

[1] According to Dr Priestley, the labours of these commentators on Locke have done more harm than good. "I think Mr Locke has been hasty in concluding that there is *some* other source of our ideas besides the external senses; but the rest of his system appears to me and others to be the corner stone of all just and rational knowledge of ourselves."

"This solid foundation, however, has lately been attempted to be overturned by a set of pretended philosophers, of whom the most conspicuous and assuming is Dr Reid, Professor of Moral Philosophy in the Univer-

least, been cleared and prepared for the labours of our posterity; and neither the cavils of the sceptic, nor the refutation of them by the sounder logician, can be pronounced to be useless to mankind. Nothing can be juster or more liberal than the following reflection of Reid: "I conceive the sceptical writers to be a set of men, whose business it is to pick holes in the fabric of knowledge wherever it is weak and faulty; and when those places are properly repaired, the whole building becomes more firm and solid than it was formerly."—(*Inquiry into the Human Mind.* Dedication.)

There is, indeed, one point of view, in which, it must be owned, that Mr Hume's *Treatise* has had an unfavourable effect (and more especially in Scotland) on the progress of Metaphysical Science. Had it not been for the zeal of some of his countrymen to oppose the sceptical conclusions, which they conceived it to be his aim to establish, much of that ingenuity which has been wasted in the refutation of his sophistry (or, to speak more correctly, in combating the mistaken principles on which he proceeded) would, in all probability, have been directed to speculations more immediately applicable to the business of life, or more agreeable to the taste of the present age. What might not have been expected from Mr Hume himself, had his powerful and accomplished mind been more frequently turned to the study of some parts of our nature (of those, for example, which are connected with the principles of criticism), in examining which, the sceptical bias of his disposition would have had fewer opportunities of leading him astray! In some fragments of this sort, which enliven and adorn his collection of *Essays*, one is at a loss whether more to admire the subtlety of his genius, or the solidity and good sense of his critical judgments

Nor have these elegant applications of metaphysical pursuits been altogether overlooked by Mr Hume's antagonists. The active and adventurous spirit of Lord Kames, here, as in many other instances, led the way to his countrymen; and, due allowances being made for the novelty and magnitude of his undertaking, with a success far greater than could have been reasonably anticipated. The *Elements of Criticism*, considered as the first systematical attempt to investigate the metaphysical principles of the fine arts, possesses, in spite of its numerous defects both in point of taste and of philosophy, infinite merits, and will ever be regarded as a literary wonder by those who know how small a portion of his time it was possible for the author to allot to the composition of it, amidst the imperious and multifarious duties of a most active and useful life. Campbell and Gerard.

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sity of Glasgow."—(*Exam. of Reid, Beattie, and Oswald*, p. 5.)—As to Mr Hume, Dr Priestley says, "In my opinion, he has been *very ably* answered, again and again, upon more solid principles than those of this new *common sense; and I beg leave to refer to the two first volumes of my Institutes of Natural and Revealed Religion.*—(*Examination of Reid &c.* Preface, p. xxvii.)

with a sounder philosophy, and Beattie, with a much more lively relish for the Sublime and the Beautiful, followed afterwards in the same path; and have all contributed to create and to diffuse over this island a taste for a higher and more enlightened species of criticism than was known to our forefathers. Among the many advantageous results with which this study has been already attended, the most important, undoubtedly, is the new and pleasing avenue which it has opened to an analysis of the laws which regulate the intellectual phenomena; and the interest which it has thus lent, in the estimation of men of the world, to inquiries which, not many years before, were seldom heard of, but within the walls of an university.

Dr Reid's two volumes of *Essays on the Intellectual and on the Active Powers of Man* (the former of which appeared in 1785, and the latter in 1788) are the latest philosophical publications from Scotland of which I shall at present take notice. They are less highly finished, both in matter and in form, than his *Inquiry into the Human Mind.* They contain also some repetitions, to which, I am afraid, I must add a few trifling inconsistencies of expression, for which the advanced age of the author, who was then approaching to fourscore, claims every indulgence from a candid reader. Perhaps, too, it may be questioned, whether, in one or two instances, his zeal for an important conclusion has not led him to avail himself of some dubious reasonings, which might have been omitted without any prejudice to his general argument. "The value of these volumes, however (as I have elsewhere remarked), is inestimable to future adventurers in the same arduous inquiries, not only in consequence of the aids they furnish as a rough draught of the field to be examined, but by the example they exhibit of a method of investigation on such subjects, hitherto very imperfectly understood, even by those philosophers who call themselves the disciples of Locke. It is by the logical rigour of this method, so systematically pursued in all his researches, still more than by the importance of his particular conclusions, that he stands so conspicuously distinguished among those who have hitherto prosecuted analytically the study of man."[1]

His acquaintance with the metaphysical doctrines of his predecessors does not appear to have been very extensive; with those of his own contemporaries it was remarkably deficient. I do not recollect that he has anywhere mentioned the names either of Condillac or of D'Alembert. It is impossible not to regret this, not only as it has deprived us of his critical judgments on some celebrated theories, but as it has prevented him from enlivening his works with that variety of historical discussion so peculiarly agreeable in these abstract researches.

[1] *Biographical Account of Reid.*

On the other hand, Dr Reid's limited range of metaphysical reading, by forcing him to draw the materials of his philosophical speculations almost entirely from his own reflections, has given to his style, both of thinking and of writing, a characteristical unity and simplicity seldom to be met with in so voluminous an author. He sometimes, indeed, repeats, with an air of originality, what had been previously said by his predecessors; but on these, as on all other occasions, he has at least the merit of thinking for himself, and of sanctioning, by the weight of his unbiassed judgment, the conclusions which he adopts. It is this uniformity of thought and design, which, according to Dr Butler, is the best test of an author's sincerity; and I am apt to regard it also, in these abstruse disquisitions, as one of the surest marks of liberal and unfettered inquiry.

In comparing Dr Reid's publications at different periods of his life, it is interesting to observe his growing partiality for the aphoristical style. Some of his *Essays on the Intellectual and Active Powers of Man* are little more than a series of detached paragraphs, consisting of leading thoughts, of which the reader is left to trace the connection by his own sagacity. To this aphoristical style it is not improbable that he was partly led by the indolence incident to advanced years, as it relieved him from what Boileau justly considered as the most difficult task of an author, the skilful management of *transitions*.[1] In consequence of this want of continuity in his compositions, a good deal of popular effect is unavoidably lost; but, on the other hand, to the few who have a taste for such inquiries, and who value books chiefly as they furnish exercise to their own thoughts (a class of readers who are alone competent to pronounce a judgment on metaphysical questions), there is a peculiar charm in a mode of writing, so admirably calculated to give *relief* to the author's ideas, and to awaken, at every sentence, the reflections of his readers.

When I review what I have now written on the history of Metaphysics in Scotland, since the publication of Mr Hume's *Treatise*, and at the same time recollect the laurels which, during the same period, have been won by Scottish authors, in every other department of literature and of science, I must acknowledge that, instead of being mortified at the slender amount of their contributions to the philosophy of the human mind, I am more disposed to wonder at their successful perseverance in cultivating a field of study, where the approbation of a few enlightened and candid judges is the only reward to which their ambition could aspire. Small as their progress may hitherto have been, it will at

[1] Boileau is said, by the younger Racine, to have made this remark in speaking of La Bruyere: "Il disoit que La Bruyere s'etoit épargné *le plus difficile d'un ouvrage* en s'épargnant les transitions." (*Mémoire sur la Vie de Jean Racine.*)

least not suffer by a comparison with what has been accomplished by their contemporaries in any other part of Europe.

It may not be useless to add in this place, that, if little has yet been done, the more ample is the field left for the industry of our successors. The compilation of a *Manual of Rational Logic*, adapted to the present state of science and of society in Europe, is a *desideratum* which, it is to be hoped, will at no distant period be supplied. It is a work, certainly, of which the execution has been greatly facilitated by the philosophical labours of the last century. The varieties of intellectual character among men present another very interesting object of study, which, considering its practical utility, has not yet excited, so much as might have been expected, the curiosity of our countrymen. Much, too, is still wanting to complete the theory of evidence. Campbell has touched upon it with his usual acuteness, but he has attempted nothing more than an illustration of a very few general principles. Nor has he turned his attention to the various illusions of the imagination, and of the passions, by which the judgment is liable to be warped in the estimates it forms of moral evidence in the common affairs of life. This is a most important inquiry, considering how often the lives and fortunes of men are subjected to the decisions of illiterate persons concerning circumstantial proofs; and how much the success or failure of every individual in the conduct of his private concerns turns on the sagacity or rashness with which he anticipates future contingencies. Since the time when Campbell wrote, an attempt has been made by Condorcet[1] and some other French writers, to apply a mathematical calculus to moral and political truths; but though much metaphysical ingenuity, as well as mathematical skill, have been displayed in carrying it into execution, it has not yet led to any useful practical results. Perhaps it may even be questioned, whether, in investigating truths of this sort, the intellectual powers can derive much aid from the employment of such an organ. To define accurately and distinctly the limits of its legitimate province, still remains a *desideratum* in this abstruse part of logic.

Nearly connected with this subject are the metaphysical principles assumed in the mathematical Calculation of Probabilities; in delivering which principles, some foreign mathematicians, with the illustrious La Place at their head, have blended, with many unquestionable and highly interesting conclusions, various moral paralogisms of the most pernicious tendency. A critical examination of these paralogisms, which are apt to escape the attention of the reader amid the variety of original and luminous discussions with which

[1] *Essai sur l'application de l'Analyse à la Probabilité des Décisions rendues à la pluralité des Voix.*

they are surrounded, would, in my humble apprehension, be one of the most essential services which could at present be rendered to true philosophy. In the mind of La Place, their origin may be fairly traced to an ambition, not altogether unnatural in so transcendant a genius, to extend the empire of his favourite science over the moral as well as the material world.[1] I have mentioned but a few out of the innumerable topics which crowd upon me as fit objects of inquiry for the rising generation.[2] Nor have I been guided in my selection of these by any other consideration, than their peculiar adaptation to the actual circumstances of the philosophical world.

Should such men as Hume, Smith, and Reid again arise, their curiosity would, in all probability, be turned to some applications of metaphysical principles of a more popular and practical nature than those which chiefly engaged their curiosity. At the same time, let us not forget what a step they made beyond the scholastic philosophy of the preceding age; and how necessary this step was as a preliminary to other researches bearing more directly and palpably on human affairs.

The most popular objection hitherto made to our Scottish metaphysicians is, that, in treating of human nature, they have overlooked altogether the corporeal part of our frame. From the contempt which they have uniformly expressed for all physiological theories concerning the intellectual phenomena, it has been concluded, that they were disposed to consider the human mind as altogether independent of the influence of physical causes. Mr Belsham has carried this charge so far, as to sneer at Dr Reid's inconsistency for having somewhere acknowledged, "in opposition to his systematical principles, that a certain constitution or state of the brain is necessary to memory." In reply to this charge, it may be confidently asserted, that no set of philosophers, since the time of Lord Bacon, have entertained juster views on this subject than the school to which Dr Reid belonged. In proof of this, I need only appeal to the *Lectures on the Duties and Qualifications of a Physician*, by the late learned and ingenious Dr John Gregory. Among the different articles connected with the natural history of the human species, which he has there recommended to the examination of the medical student, he lays particular stress on "the laws of union

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[1] The paralogisms to which I allude did not fall within the scope of the admirable criticism on this work in the Edinburgh *Review*.

[2] Among these, the most prominent is the Natural or Theoretical History of Language (including under this title *written* as well as *oral* language), a subject which will probably continue to furnish new problems to human ingenuity, in the most improved state of human knowledge. It is not surprising, that an art which lays the foundation of all the others, and which is so intimately connected with the exercise of reason itself, should leave behind it such faint and obscure traces of its origin and infancy.

between the mind and body, and the mutual influence they have upon one another." "This (he observes) is one of the most important inquiries that ever engaged the attention of mankind, and almost equally necessary in the sciences of morals and of medicine." It must be remarked, however, that it is only the *laws* which regulate the union between mind and body (the same class of *facts* which Bacon called the *doctrina de fœdere*), which are here pointed out as proper objects of philosophical curiosity; for as to any *hypothesis* concerning the *manner* in which the union is carried on, this most sagacious writer was well aware, that they are not more unfavourable to the improvement of logic and of ethics, than to a skilful and judicious exercise of the healing art.

I may perhaps form too high an estimate of the progress of knowledge during the last fifty years; but I think I can perceive, within the period of my own recollection, not only a change to the better in the Philosophy of the Human Mind, but in the speculations of medical inquirers. Physiological theories concerning the functions of the nerves in producing the intellectual phenomena have pretty generally fallen into contempt: and, on the other hand, a large accession has been made to our stock of well authenticated facts, both with respect to the influence of body on mind, and of mind upon body. As examples of this, it is sufficient to mention the experimental inquiries instituted, in consequence of the pretended cures effected by means of Animal Magnetism and of Tractors; to which may be added, the philosophical spirit evinced in some late publications on Insanity.

Another objection, not so entirely groundless, which has been made to the same school, is, that their mode of philosophising has led to an unnecessary multiplication of our *internal senses and instinctive determinations*. For this error, I have elsewhere attempted to account and to apologize.[1] On the present occasion I shall only remark, that it is at least a safer error than the opposite extreme, so fashionable of late among our southern neighbours, of endeavouring to explain away, without any exception, all our *instinctive* principles, both speculative and practical. A literal interpretation of Locke's comparison of the infant mind to a *sheet of white paper* (a comparison which, if I am rightly informed, has not yet wholly lost its credit in all our universities), naturally predisposed his followers to embrace this theory, and enabled them to shelter it from a free examination, under the sanction of his supposed authority. Dr Paley, himself, in his earliest philosophical publication, yielded so far to the prejudices in which he had been educated, as to dispute the existence of the *moral faculty*;[2] although, in his more advanced years, he amply aton-

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[1] *Biographical Memoirs*, p. 472.

[2] After relating, in the words of Valerius Maximus, the noted story of Caius Toranus, who betrayed his affectionate and excellent father to the triumvirate, Dr. Paley thus proceeds:

ed for this error of his youth, by the ingenuity and acuteness with which he combated the reasonings employed by some of his contemporaries, to invalidate the proofs afforded by the phenomena of *instinct*, of the existence of a designing and provident cause. In this part of his work, he has plainly in his eye the *Zoonomia* of Dr Darwin,[1] where the same principles, of which Paley and others had availed themselves to disprove the existence of instinct and instinctive propensities in man, are eagerly laid hold of to disprove the existence of *instinct* in the brutes. Without such an extension of the argument, it was clearly perceived by Darwin, that sufficient evidences of the existence of a Designing Cause would be afforded by the phenomena of the lower animals; and, accordingly, he has employed much ingenuity to show, that all these phenomena may be accounted for by experience, or by the influence of pleasurable or painful sensations, operating *at the moment* on the animal frame.

In opposition to this theory, it is maintained by Paley, that it is by *instinct*, that

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"Now the question is, whether, if this story were related to the wild boy caught some years ago in the woods of Hanover, or to a savage without experience and without instruction, cut off in his infancy from all intercourse with his species, and consequently under no possible influence of example, authority, education, sympathy, or habit; whether, I say, such a one would feel, upon the relation, any degree of that *sentiment of disapprobation of Toranius's conduct* which we feel or not?"

"They who maintain the existence of a moral sense, of innate maxims, of a natural conscience—that the love of virtue and hatred of vice are instinctive, or the perception of right or wrong intuitive (all of which are only different ways of expressing the same opinion), affirm that he would.

"They who deny the existence of a moral sense, &c. affirm that he would not.

"And upon this issue is joined." (*Principles of Moral and Political Philosophy*, B. I. Chap. 5.)

To those who are at all acquainted with the history of this dispute, it must appear evident that the question is here completely misstated; and that, in the whole of Dr Paley's subsequent argument on the subject, he combats a phantom of his own imagination. The opinion which he ascribes to his antagonists has been loudly and repeatedly disavowed by all the most eminent moralists who have disputed Locke's reasonings against *innate practical principles;* and is, indeed, so very obviously absurd, that it never could have been for a moment entertained by any person in his senses.

Did it ever enter into the mind of the wildest theorist to imagine that the sense of seeing would enable a man brought up, from the moment of his birth, in utter darkness, to form a conception of light and colours? But would it not be equally rash to conclude from the extravagance of such a supposition, that the sense of seeing is not an original part of the human frame?

The above quotation from Paley forces me to remark, farther, that, in combating the supposition of a *moral sense*, he has confounded together, as *only different ways of expressing the same opinion*, a variety of systems, which are regarded by all our best philosophers, not only as essentially distinct, but as in some measure standing in opposition to each other. The system of Hutcheson, for example, is identified with that of Cudworth But although, in this instance, the author's logical discrimination does not appear to much advantage, the sweeping censure thus bestowed on so many of our most celebrated ethical theories, has the merit of throwing a very strong light on that particular view of the subject which it is the aim of his reasonings to establish, in contradiction to them all.

[1] See the section on Instinct. (Sect. XVI. of that work.)

is (according to his own definition), "by a propensity prior to experience, and independent of instruction," "that the sexes of animals seek each other; that animals cherish their offspring; that the young quadruped is directed to the teat of its dam; that birds build their nest, and brood with so much patience upon their eggs; that insects, which do not sit upon their eggs, deposit them in those particular situations in which the young, when hatched, find their appropriate food; that it is instinct which carries the salmon, and some other fish, out of the sea into rivers, for the purpose of shedding their spawn in fresh water."[1]

In Dr Paley's very able and convincing reasonings on these various points, he has undoubtedly approached nearer to the spirit of what has been ironically called *Scottish* philosophy,[2] than any of Mr Locke's English disciples, since the time of Dr Butler: a circumstance which, when compared with the metaphysical creed of his earlier years, reflects the greatest honour on the candour and fairness of his mind, and encourages the hope, that this philosophy, where it is equally sound, will gradually and silently work its way among sincere inquirers after truth, in spite of the strong prejudices which many of our southern neighbours still appear to entertain against it. The extravagancies of Darwin, it is probable, first opened Dr Paley's eyes to the dangerous tendency of Locke's *argument against innate* principles, when inculcated without due limitations.[3]

With this very faint outline of the speculations of Locke's chief successors in Scot

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[1] Paley's *Natural Theology*, p. 324.

[2] May I take the liberty of requesting the reader to compare a few pages of Dr Paley's Section on Instinct, beginning, "*I am not ignorant of the theory which resolves instinct into sensation*," &c. with some remarks made by the author of this Dissertation, in an Account of the Life and Writings of Dr Reid? See the passage in section second, beginning thus, "*In a very original work, on which I have already hazarded some criticisms*," &c. As both publications appeared about the same time (in the year 1802), the coincidence, in point of thought, must have been wholly accidental, and as such affords no slight presumption in favour of its soundness.

[3] When Dr Paley published his *Principles of Moral and Political Philosophy*, he seems to have attached himself much too slavishly to the opinions of Bishop Law, to whom that work is inscribed. Hence, probably, his anxiety to disprove the existence of the moral faculty. Of the length to which Law was disposed to carry Locke's argument against innate principles, he has enabled us to judge by his own explicit declaration: "I take implanted *senses, instincts, appetites, passions, and affections*, &c. to be a remnant of the old philosophy, which used to call every thing *innate* that it could not account for; and therefore heartily wish, that they were in one sense all eradicated, which was undoubtedly the aim of that great author last mentioned (Mr Locke), as it was a natural consequence of his first book." (Law's translation of Archbishop King *On the Origin of Evil*, p. 79, note.)

In justice, however, to Dr Law, it must be observed, that he appears to have been fully aware that the

land, prior to the close of Dr. Reid's literary labours, I shall for the present finish my review of the metaphysical pursuits of the eighteenth century. The long period which has since elapsed has been too much crowded with great political events to favour the growth of abstract science in any of its branches; and of the little which appears to have been done, during this interval, in other parts of Europe, towards the advancement of true philosophy, the interrupted communication between this island and the Continent left us for many years in a state of almost total ignorance. This chasm, in our information concerning foreign literature, it may not be a difficult task for younger men to supply. At my time of life it would be folly to attempt it; nor, perhaps, is any author, who has himself been so frequently before the public, the fittest person to form an impartial estimate of the merits of his living contemporaries. Now, however, when peace is at length restored to the world, it may reasonably be hoped that the human mind will again resume her former career with renovated energy; and that the nineteenth century will not yield to the eighteenth in furnishing materials to those who may hereafter delight to trace the progressive improvement of their species. In the meantime, instead of indulging myself in looking forward to the future, I shall conclude this section with a few general reflections suggested by the foregoing retrospect.

Among these reflections, what chiefly strikes my own mind is the extraordinary change which has gradually and insensibly taken place since the publication of Locke's *Essay*, in the meaning of the word *Metaphysics;* a word formerly appropriated to the ontology and pneumatology of the schools, but now understood as equally applicable to all those inquiries, which have, for their object, to trace the various branches of human knowledge to their first principles in the constitution of our nature.[1] This change can be accounted for

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dispute about innate principles was in a great measure verbal. "It will really (says he) come to the same thing with regard to the moral attributes of God and the nature of virtue and vice, whether the Deity has *implanted* these instincts and affections in us, or has framed and disposed us in such a manner, has given us such powers, and placed us in such circumstances, that we must *necessarily acquire them.*" (*Ibid.*) But if Dr Law was aware of this, why should he and his followers have attached such infinite importance to the controversy?

[1] The following is the account of Metaphysics given by Hobbes.—"There is a certain *Philosophia prima*, on which all other Philosophy ought to depend; and consisteth principally in right limiting of the significations of such appellations, or names, as are of all others the most universal: which limitations serve to avoid ambiguity, and equivocation in reasoning; and are commonly called Definitions, such as are the Definitions of Body, Time, Place, Matter, Form, Essence, Subject, Substance, Accident, Power, Act, Finite, Infinite, Quantity, Quality, Motion, Action, Passion, and divers others, necessary to the explaining of a man's conceptions concerning the nature and generation of bodies. The explication (that is, the settling of the meaning) of which, and the like terms, is commonly in the schools called *Metaphysics.*" (*Moral and Political Works.* Folio Edit. London, 1750. p. 399.)

only by a change in the philosophical pursuits of Locke's successors; a change from the idle abstractions and subtleties of the dark ages, to studies subservient to the culture of the understanding; to the successful exercise of its faculties and powers; and to a knowledge of the great ends and purposes of our being. It may be regarded, therefore, as a palpable and incontrovertible proof of a corresponding progress of reason in this part of the world.

On comparing together the multifarious studies now classed together under the title of Metaphysics, it will be found difficult to trace any common circumstance but this, that they all require the same sort of mental exertion for their prosecution; the exercise, I mean, of that power (called by Locke *Reflection*) by which the mind turns its attention inwards upon its own operations, and the subjects of its own consciousness. In researches concerning our intellectual and active powers, the mind directs its attention to the faculties which it exercises, or to the propensities which put these faculties in motion. In all the other inquiries which fall under the province of the Metaphysician, the materials of his reasoning are drawn chiefly from his own internal resources. Nor is this observation less applicable to speculations which relate to things external, than to such as are confined to the thinking and sentient principle within him. In carrying on his researches (for example) concerning hardness, softness, figure, and motion, he finds it not less necessary to retire within himself, than in studying the laws of imagination or memory. Indeed, in such cases, the whole aim of his studies is to obtain a more precise definition of his *ideas*, and to ascertain the occasions on which they are formed.

From this account of the nature and object of metaphysical science, it may be reasonably expected, that those with whom it is a favourite and habitual pursuit, should acquire a more than ordinary capacity of retiring, at pleasure, from the external to the internal world They may be expected also to acquire a disposition to examine the origin of whatsoever combinations they may find established in the fancy, and a superiority to the casual associations which warp common understandings. Hence an accuracy and a subtlety in their distinctions on all subjects, and those peculiarities in their views which are characteristical of unbiassed and original thinking. But, perhaps, the most valuable fruit of their researches, is that scrupulous precision in the use of language, upon which, more than upon any one circumstance whatever, the logical accuracy of our reasonings, and the justness of our conclusions, essentially depend. Accordingly it will be found, on a review of the history of the moral sciences, that the most important steps which have been made in some of those, apparently the most remote from metaphysical pursuits (in the science, for example, of political economy), have been made by men trained to the exercise of their intellectual

powers by early habits of abstract meditation. To this fact Burke probably alluded, when he remarked, that "by turning the soul inward on itself, its forces are concentered, and are fitted for stronger and bolder flights of science; and that in such pursuits, whether we take, or whether we lose the game, the chace is certainly of service." The names of Locke, of Berkeley, of Hume, of Quesnai, of Turgot, of Morellet, and above all, of Adam Smith, will at once illustrate the truth of these observations, and show, that, in combining together, in this Dissertation, the sciences of Metaphysics, of Ethics, and of Politics, I have not adopted an arrangement altogether capricious.[1]

In farther justification of this arrangement, I might appeal to the popular prejudices so industriously fostered by many, against these three branches of knowledge, as ramifications from one common and most pernicious root. How often have Mr Smith's reasonings in favour of the freedom of trade been ridiculed as *metaphysical* and visionary! Nay, but a few years have elapsed, since this epithet (accompanied with the still more opprobrious terms of Atheistical and Democratical) was applied to the argument then urged against the morality and policy of the slave-trade; and, in general, to every speculation in which any appeal was made to the beneficent arrangements of nature, or to the progressive improvement of the human race. Absurd as this language was, it could not, for a moment, have obtained any currency with the multitude, had there not been an obvious connection between these liberal doctrines, and the well known habits of logical thinking, which so eminently distinguished their authors and advocates. Whatever praise, therefore, may be due to the fathers of the modern science of political economy, belongs, at least in part (according to the acknowledgment of their most decided adversaries), to those abstract studies by which they were prepared for an analytical investigation of its first and fundamental principles.

Other connections and affinities between Political Economy and the Philosophy of the

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[1] It furnishes no objection to these remarks, that some of our best treatises on questions of political economy have proceeded from men who were strangers to metaphysical studies. It is enough for my purpose if it be granted, that it was by habits of metaphysical thinking that the minds of those authors were formed, by whom political economy was first exalted to the dignity of a science. To a great proportion even of the learned, the rules of a sound logic are best taught by examples, and when a precise and well-defined phraseology is once introduced, the speculations of the most ordinary writers assume an appearance (sometimes, it must be owned, a very fallacious one) of depth and consistency.

Fontenelle remarks, that a single great man is sufficient to accomplish a change in the taste of his age, and that the perspicuity and method for which Descartes was indebted to his mathematical researches, were successfully copied by many of his contemporaries who were ignorant of mathematics. A similar observation will be found to apply, with still greater force, to the models of metaphysical analysis and of logical discussion, exhibited in the political works of Hume and of Smith.

Human Mind will present themselves afterwards. At present I purposely confine myself to that which is most obvious and indisputable.

The influence of metaphysical studies may be also perceived in the philosophical spirit so largely infused into the best historical compositions of the last century. This spirit has, indeed, been often perverted to pernicious purposes; but who can doubt, that, on the whole, both history and philosophy have gained infinitely by the alliance?

How far a similar alliance has been advantageous to our poetry, may be more reasonably questioned. But on the most unfavourable supposition it must be admitted, that the number of poetical readers has thereby been greatly increased, and the pleasures of imagination proportionally communicated to a wider circle. The same remark may be extended to the study of philosophical criticism. If it has not contributed to the encouragement of original genius in the fine arts, it has been followed by a much more beneficial result in diffusing a relish for the beautiful and the elegant; not to mention its influence in correcting and fixing the public taste, by the precision and steadiness of the principles to which it appeals.[1]

Another instance, still more important, of the practical influence of metaphysical science, is the improvement which, since the time of Locke, has become general in the conduct of education, *both private and public*. In the former case, the fact is universally acknowledged. But even in our universities (notwithstanding the proverbial aversion of most of them to everything which savours of innovation) what a change has been gradually accomplished since the beginning of the eighteenth century! The studies of Ontology, of Pneumatology, and of Dialectics, have been supplanted by that of the Human Mind, conducted with more or less success, on the plan of Locke's *Essay;* and, in a few seats of learning, by the studies of Bacon's Method of Inquiry, of the Principles of Philosophical Criticism, and of the Elements of Political Economy. In all this an approach has been made or attempted, to what Locke so earnestly recommended to parents, "that their children's time should be spent in acquiring what may be useful to them when they come to be men." Many other circumstances, no doubt, have contributed their share in producing this revolution; but what individual can be compared to Locke in giving the first impulse to that spirit of reform by which it has been established?[2]

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[1] See some admirable remarks on this subject by Gray, in his comments on the *Io* of Plato. (Edition of *Gray*, by Mathias.)

[2] Under this head of education may also be mentioned the practical improvements which, during the course of the last century, have taken place in what Lord Bacon calls *the traditive part of logic*. I allude here not only to the new arrangements in the Lancastrian Schools, by which the diffusion of the art of reading among

In consequence of the operation of these causes, a sensible change has taken place in the style of English composition.[1] The number of idiomatical phrases has been abridg-

the poorer classes of the community is so wonderfully facilitated and extended, but to those admirable elementary works which have opened a ready and speedy access to the more recondite truths of the severer sciences. How much these have contributed to promote the progress of mathematical knowledge in France, may be judged of from an assertion of Condorcet, that two years spent under an able teacher now carry the student beyond the conclusions which limited the researches of Leibnitz and of Newton. The Essays lately published on this subject by M. Lacroix (*Essais sur l'Enseignement en Général, et sur celui des Mathématiques en particulier.* Paris, 1805) contain many valuable suggestions, and, beside their utility to those who are concerned in the task of instruction, may justly be considered as an accession to the Philosophy of the Human Mind.

[1] See some judicious remarks on this subject in Mr Godwin's *Inquirer*, p. 271. In the opinion of this author, "the English language is now written with more grammatical propriety than by the best of our ancestors; and with a much higher degree of energy and vigour. The spirit of philosophy has infused itself into the structure of our sentences." He remarks farther, in favour of the present style of English composition, "that it at once satisfies the understanding and the ear." The union of these two excellencies certainly constitutes the perfection of writing. Johnson boasts, and with truth, in the concluding paper of the *Rambler*, that he had "added something to our language in the elegance of its construction, and something in the harmony of its cadence;" but what a sacrifice did he make to these objects, of conciseness, of simplicity, and of (what he has himself called) *Genuine Anglicism*. To accomplish the same ends, without any sacrifice of these higher merits, has been one of the chief aims of the most eminent among his successors.

As an instrument of thought and a medium of scientific communication, the English language appears to me, in its present state, to be far superior to the French. Diderot, indeed (a very high authority), has, with much confidence, asserted the contrary; and it is but fair to let him speak for himself: "J'ajouterois volontiers que la marche didactique et reglée à laquelle notre langue est assujettie la rend plus propre aux sciences; et que par les tours et les inversions que le Grec, le Latin, l'Italien, l'Anglois, se permettent, ces langues sont plus avantageuses pour les lettres: Que nous pouvons mieux qu'aucun autre peuple faire parler l'esprit: et que le bon sens choisiroit la langue Françoise; mais que l'Imagination et les passions donneroient la préférence aux langues anciennes et à celles de nos voisins. Qu'il faut parler François dans la societé et dans les écoles de Philosophie; et Grec, Latin, Anglois, dans les chaires et sur le Theâtre: Que notre langue seroit celle de la vérité, si jamais elle revient sur la terre, et que la Grecque, la Latine, et les autres seroient les langues de la fable et du mensonge. Le François est fait pour instruire, eclairer, et convaincre; le Grec, le Latin, l'Italien, l'Anglois, pour persuader, émouvoir, et tromper; parlez Grec, Latin, Italien au peuple, mais parlez François au sage." (*Œuvres de Diderot*, Tome II. pp. 70, 71. Amsterdam, 1772.)

These peculiar excellencies of the French language are ascribed, in part, by Diderot, to the study of the Aristotelian Philosophy. (*Ibid.* p. 7.) I do not well see what advantage France should, in this respect, have enjoyed over England; and since that philosophy fell into disrepute, it will scarcely be alleged that the habits of thinking cultivated by Locke's disciples have been less favourable to a logical rigour of expression than those of any contemporary sect of French metaphysicians.

A later French writer has, with far greater justice, acknowledged the important services rendered to the French language by the gentlemen of the Port Royal Society. "L'Ecole de Port Royal, féconde en penseurs, illustrée par les écrivains les plus purs, par les érudits les plus laborieux du siècle de Louis XIV. eût déja rendu parmi nous un assez grand service à la philosophie par cela seul qu'elle a puissament concouru à fixer notre langue, à lui donner ce caractère de précision, de clarté, d'exactitude, qui la rend si favorable aux opérations de l'esprit" (*Hist. Comparée*, &c. Tome II. p. 45.)

Mr Gibbon also has remarked, how much "the learned Society of Port Royal contributed to establish in France

ed; and the language has assumed a form more systematic, precise, and luminous. The transitions, too, in our best authors, have become more logical, and less dependent on fanciful or verbal associations. If by these means our native tongue has been rendered more unfit for some of the lighter species of writing, it has certainly gained immensely as an instrument of thought, and as a vehicle of knowledge. May I not also add, that the study of it has been greatly facilitated to foreigners; and that in proportion to its rejection of colloquial anomalies, more durable materials are supplied to the present generation for transmitting their intellectual acquisitions to posterity?

But granting the truth of these reflections, it may still be asked, what is the amount of the discoveries brought to light by the metaphysical speculations of the eighteenth century? Or rather, where are the principles to be found, of which it can be justly said, that they unite the suffrages, not of the *whole*, but even of the *majority* of our present philosophers? The question has been lately put and urged, with no common ability, by a foreign academician.

"The diversity of doctrines (says M. de Bonald) has increased, from age to age, with the number of masters, and with the progress of knowledge; and Europe, which at present possesses libraries filled with philosophical works, and which reckons up almost as many philosophers as writers; poor in the midst of so much riches, and uncertain with the aid of all its guides, which road it should follow; Europe, the centre and the focus of all the lights of the world, has yet its *philosophy* only in expectation."[1]

In proof of this assertion, the author appeals to the *Comparative History of Philosophical Systems relative to the Principles of Human Knowledge*, by M. de Gerando; and, after a variety of acute strictures on the contradictory systems there described, sums up his argument in the following words:

"Thus, the *Comparative History of Philosophical Systems* is nothing else than a *History of the Variations* of philosophical schools, leaving no other impression upon the reader than an insurmountable disgust at all philosophical researches; and a demonstrated conviction of the impossibility of raising an edifice on *a soil so void of consistency, and so completely surrounded by the most frightful precipices*. About what then are philosophers agreed? What single point have they placed beyond the reach of dispute? Plato and Aristotle inquired, What is science? What is knowledge? And we, so many ages

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a taste for just reasoning, simplicity of style, and philosophical method." The improvement in all these respects of our English writers, during the same period, is, in my opinion, much more remarkable.

[1] *Recherches Philosophiques*. &c. p. 2. Paris, 1818.

after these fathers of philosophy; we, so proud of the progress of human reason, still continue to repeat the same questions; vainly pursuing the same phantoms which the Greeks pursued two thousand years ago."[1]

In reply to this bold attack on the evidence of the moral sciences, it may suffice to recal to our recollection the state of physical science not more than two centuries ago. The argument of M. de Bonald against the former is, in fact, precisely the same with that ascribed by Xenophon to Socrates against those studies which have immortalized the names of Boyle and Newton; and which, in our own times, have revealed to us all the wonders of the modern chemistry. Whatever contradictions, therefore, may yet exist in our metaphysical doctrines (and of these contradictions many more than is commonly suspected will be found to be merely verbal), why should we despair of the success of future ages in tracing the laws of the intellectual world, which, though less obvious than those of the material world, are not less the natural and legitimate objects of human curiosity?

Nor is it at all wonderful that the beneficial effects of metaphysical habits of thinking should have been at first perceived in political economy, and some other sciences to which, on a superficial view, they may seem to have a very remote relation; and that the rise of the sap in the tree of knowledge should be indicated by the germs at the extremities of the branches before any visible change is discernible in the trunk. The sciences, whose improvement during the last century has been generally acknowledged, are those which are most open to common observation; while the changes which have taken place in the state of metaphysics, have attracted the notice of the few alone who take a deep interest in these abstract pursuits. The swelling of the buds, however, affords a sufficient proof that the roots are sound, and encourages the hope that the growth of the trunk, though more slow, will, in process of time, be equally conspicuous with that of the leaves and blossoms.

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[1] *Recherches Philosophiques*, &c. pp. 58, 59.

On the other hand, may it not be asked, if the number of philosophical systems be greater than that of the sects which at present divide the Christian Church? The allusion here made to Bossuet's celebrated *History of the Variations*, shows plainly that the similarity of the two cases had not been overlooked by the ingenious writer; and that the only effectual remedy which, in his opinion, can be applied to either, is to subject once more the reason, both of philosophers and of divines, to the paramount authority of an infallible guide. The conclusion is such as might have been expected from a good Catholic; but I trust that, in this country, it is not likely to mislead many of my readers. Some recent conversions to Popery, however, which, in consequence of views similar to those of M. de Bonald, have taken place among the philosophers of Germany, afford a proof that, in the present political state of Europe, the danger of a temporary relapse into the superstitions of the Church of Rome, how slight soever, ought not to be regarded as altogether visionary. (See *Lectures on the History of Literature*, by Frederick Schlegel, Vol. II. pp. 65, 88, 89, 175, 187. English Translation, Edinburgh.)

I shall close this part of my Dissertation with remarking, that the practical influence of such speculations as those of Locke and of Bacon is to be traced only by comparing, on a large scale, the state of the human mind at distant periods. Both these philosophers appear to have been fully aware (and I know of no philosopher before them of whom the same thing can be said), that the progressive improvement of the species is to be expected less from the culture of the *reasoning powers*, strictly so called, than from the prevention, in early life, of those artificial impressions and associations, by means of which, when once rivetted by habit, the strongest reason may be held in perpetual bondage. These impressions and associations may be likened to the slender threads which fastened Gulliver to the earth; and they are to be overcome, not by a sudden exertion of intellectual force, but by the gradual effect of good education, in breaking them asunder one by one. Since the revival of letters, seconded by the invention of printing, and by the Protestant Reformation, this process has been incessantly going on, all over the Christian world; but it is chiefly in the course of the last century that the result has become visible to common observers. How many are the threads which, even in Catholic countries, have been broken by the writings of Locke! How many still remain to be broken, before the mind of man can recover that moral liberty which, at some future period, it seems destined to enjoy!

NOTES AND ILLUSTRATIONS.

NOTE (A.) p. 10.

IT deserves to be remarked, as a circumstance which throws considerable light on the literary history of Scotland during the latter half of the eighteenth century, that, from time immemorial, a continued intercourse had been kept up between Scotland and the Continent. To all who were destined for the profession of law, an education either at a Dutch or French university was considered as almost essential. The case was nearly the same in the profession of physic; and, even among the Scottish clergy, I have conversed, in my youth, with some old men who had studied theology in Holland or in Germany. Of our smaller country gentlemen, resident on their own estates (an order of men which, from various causes, has now, alas! totally vanished), there was scarcely one who had not enjoyed the benefit of a university education; and very few of those who could afford the expence of foreign travel, who had not visited France and Italy. Lord Monboddo somewhere mentions, to the honour of his father, that he sold part of his estate to enable himself (his eldest son) to pursue his studies at the University of Groninguen. The constant influx of information and of liberality from abroad, which was thus kept up in Scotland in consequence of the ancient habits and manners of the people, may help to account for the sudden burst of genius, which to a foreigner must seem to have sprung up in this country by a sort of enchantment, soon after the rebellion of 1745. The great step *then* made was in the art of English composition. In the mathematical sciences, where the graces of writing have no place, Scotland, in proportion to the number of its inhabitants, was never, from the time of Neper, left behind by any country in Europe; nor ought it to be forgotten, that the philosophy of Newton was publicly taught by David Gregory at Edinburgh and by his brother James Gregory at St Andrews, before it was able to supplant the vortices of Descartes in that very university of which Newton was a member.[1]

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[1] For this we have the authority of Whiston, the immediate successor of Sir Isaac Newton in the Lucasian Professorship at Cambridge; and of Dr Reid, who was a nephew of the two Gregorys. "Mr Gregory had already caused several of his scholars to keep Acts, as we call them, upon several branches of the Newtonian Philosophy; while we at Cambridge, poor wretches, were ignominiously studying the fictitious hypothesis of the Cartesians. (Whiston's *Memoirs of his own Life.*)

"I have by me" (says Dr Reid) "a *Thesis* printed at Edinburgh, 1690, by James Gregory, who was at that time Professor of Philosophy at St Andrew's, containing twenty-five positions; the first three relating to logic, and the abuse of it in the Aristotelian and Cartesian philosophy. The remaining twenty-two positions are a compend of Newton's *Principia*. This *Thesis*, as was the custom at that time in the Scottish Universities, was to be defended in a public disputation, by the candidates, previous to their taking their degree."—(Hutton's *Mathematical Dictionary*.—*Supplement* by Dr Reid to the article *Gregory*.

The case was similar in every other liberal pursuit, where an ignorance of the delicacies of the English tongue was not an insuperable bar to distinction. Even in the study of eloquence, as far as it was attainable in their own vernacular idiom, some of the Scottish pleaders, about the era when the two kingdoms were united, seem ambitiously, and not altogether unsuccessfully, to have formed themselves upon models, which, in modern times, it has been commonly supposed to be more safe to admire than to imitate.[1] Of the progress made in this part of the island in Metaphysical and Ethical Studies, at a period long prior to that which is commonly considered as the commencement of our literary history, I shall afterwards have occasion to speak. At present, I shall only observe, that it was in the Scottish universities that the philosophy of Locke, as well as that of Newton, was first adopted as a branch of academical education.

Note (B.) p. 14.

Extract of a letter from M. Allamand to Mr Gibbon. (See Gibbon's *Miscellaneous Works.*)

"Vous avez sans doute raison de dire que les propositions évidentes dont il s'agit, ne sont pas de simples idées, mais des jugemens. Mais ayez aussi la complaisance de reconnôitre que M Locke les alleguant en exemple d'idées qui passent pour innées, et qui ne le sont pas selon lui, s'il y a ici de la méprise, c'est lui qu'il faut relever la-dessus, et non pas moi, qui n'avois autre chose à faire qu'à refuter sa manière de raisonner contre l'innéité de ces idées ou jugemens là. D'ailleurs, Monsieur, vous remarquerez, s'il vous plait, que dans cette dispute il s'agit en effet, de savoir si certaines vérités évidentes et communes, et non pas seulement certaines idées simples, sont innées ou non. Ceux qui affirment, ne donnent guère pour exemple d'idées simples qui le soyent, que celles de Dieu, de l'unité, et de l'existence; les autres exemples sont pris de propositions completes, que vous appellez jugemens.

"Mais, dites vous, y aura-t-il donc des jugemens innés? Le jugement est il autre chose qu'un acte de nos facultés intellectuelles dans la comparaison des idées? Le jugement sur les vérités évidentes, n'est il pas une simple vue de ces vérités là, un simple coup d'œil que l'esprit jette sur elles? J'accorde tout cela. *Et de grace, qu'est ce qu'* idée? *N'est ce pas* vue, *ou coup d'œil, si vous voulez?* Ceux qui définissent l'idée autrement, ne s'eloignent-ils pas visiblement du sens et de l'intention du mot? Dire que les idées sont les *especes* des choses imprimées dans l'esprit, comme l'image de l'objet sensible est tracée dans l'œil, n'est ce pas jargonner plutôt que définir? Or c'est la faute, qu'ont fait tous les metaphysiciens, et quoique M. Locke l'ait bien sentie, il a mieux aimé se facher contre eux, et tirer contre les girouettes de la place, que s'appliquer à dèmêler ce galimatias. Que n'a-t-il dit, non seulement il n'y a point d'idées innées dans le sens de ces Messieurs; mais *il n'y a point d'idées du tout dans ce sens lá; toute idée est un acte, une vue, un coup d'œil de l'esprit.* Dès-lors demander s'il y a des idées innées, c'est demander s'il y a certaines vérités si évidentes et si communes que tout esprit non stupide puisse naturellement, sans culture et sans maître, sans discussion, sans raisonnement, les reconnoitre d'un coup d'œil, et souvent même sans s'apperçevoir qu'on jette ce coup d'œil. L'affirmative me paroit incontestable, et selon moi, la question est vuidée par là.

[1] See a splendid eulogium in the Latin language, by Sir George Mackenzie, on the most distinguished pleaders of his time at the Scottish Bar. Every allowance being made for the flattering touches of a friendly hand, his portraits can scarcely be supposed not to have borne a strong and characteristical resemblance to the originals from which they were copied.

"Maintenant prenez garde, Monsieur, que cette manière d'entendre l'affaire, va au but des partisans des idées innées, tout comme la leur; et par la même contredit M. Locke dans le sien. Car pourquoi voudroit on qu'il y a eu des idées innées? Ce'st pour en opposer la certitude et l'evidence au doute universal des sceptiques, qui est ruiné d'un seul coup, s'il y a des vérités dont la vue soit nécessaire et naturelle à l'homme. Or vous sentez, Monsieur, que je puis leur dire cela dans ma façon d'expliquer la chose, tout aussi bien que les partisans ordinaires des idées innées dans la leur. Et voilà ce que semble incommoder un peu M. Locke, qui, sans se declarer Pyrrhonien, laisse apperçevoir un peu trop de foible pour le Pyrrhonisme, et a beaucoup contribué à le nourrir dans ce siècle. A force de vouloir marquer les bornes de nos connoissances, ce qui etoit fort necessaire, il a quelquefois tout mis en bornes."

NOTE (C.) p. 15.

"A DECISIVE proof of this is afforded by the allusions to Locke's doctrines in the dramatic pieces then in possession of the French stage," &c.

In a comedy of Destouches (entitled *La Fausse Agnes*), which must have been written long before the period in question,[1] the heroine, a lively and accomplished girl, supposed to be just arrived from Paris at her father's house in Poitou, is introduced as first assuming the appearance of imbecility, in order to get rid of a disagreeable lover; and afterwards, as pleading her own cause in a mock trial before an absurd old president and two provincial ladies, to convince them that she is in reality not out of her senses. In the course of her argument on this subject, she endeavours to astonish her judges by an ironical display of her philosophical knowledge; warning them of the extreme difficulty and nicety of the question upon which they are about to pronounce. "Vous voulez juger de moi! mais, pour juger sainement, il faut une grande étendue de connoissance; encore est il bien douteux qu'il y en ait de certaines. . . . . Avant donc que vous entrepreniez de prononcer sur mon sujet, je demande préalablement que vous examiniez avec moi nos connoissances en general, les degrès de ces connoissances, leur étendue, leur réalité; que nous convenions de ce que c'est que la vérité et si la vérité se trouve effectivement. Après quoi nous traiterons des propositions universelles, des maximes, des propositions frivoles, et de la foiblesse, ou de la solidité de nos lumières . . . . Quelque personnes tiennent pour vérité, que l'homme nâit avec certains principes innées, certaines notions primitives, certains caractères que sont comme gravés dans son esprit, dès le premier instant de son existence. Pour moi, j'ai longtemps examiné ce sentiment, et j'entreprends de le combattre, de le refuter, de l'aneantir, si vous avez la patience de m'ecouter." I have transcribed but a part of this curious pleading; but I presume more than enough to show, that every sentence, and almost every word of it, refers to Locke's doctrines. In the second and third sentences, the titles of the principal chapters in the fourth book of his *Essay* are exactly copied. It was impossible that such a scene should have produced the slightest comic effect, unless the book alluded to had been in very general circulation among the higher orders; I might perhaps add, in much

[1] This little piece was first published in 1757, three years after the author's death, which took place in 1754, in the seventy-fourth year of his age. But we are told by D'Alembert, that from the age of sixty, he had renounced, from sentiments of piety, all thoughts of writing for the stage. (*Eloge de Destouches.*) This carries the date of *all* his dramatic works, at least as far back as 1740. As for Destouches' own familiarity with the writings of Locke, it is easily accounted for by his residence in England from 1717 to 1723, where he remained, for some time after the departure of Cardinal Dubois, as *Charge d'Affaires*. Voltaire did not visit England till 1727.

more general circulation than it ever obtained among that class of readers in England. At no period, certainly, since it was first published (such is the difference of national manners), could similar allusions have been made to it, or to any other work on so abstract a subject, with the slightest hope of success on the London stage. And yet D'Alembert pronounces *La Fausse Agnes* to be a piece, *pleine de mouvement et de gaieté*.

Note (D.) p. 18.

"Descartes asserted" (says a very zealous Lockist, M. de Voltaire), "that the soul, at its coming into the body, is informed with the whole series of metaphysical notions; knowing God, infinite space, possessing all abstract ideas; in a word, completely endued with the most sublime lights, which it unhappily forgets at its issuing from the womb.

"With regard to myself" (continues the same writer), "I am as little inclined as Locke could be, to fancy that, some weeks after I was conceived, I was a very learned soul; knowing at that time a thousand things which I forgot at my birth; and possessing, when in the womb (though to no manner of purpose), knowledge which I lost the instant I had occasion for it; and which I have never since been able to recover perfectly."—*Letters Concerning the English Nation*. Letter 13.

Whatever inferences may be deducible from some of Descartes's expressions, or from the comments on these expressions by some who assumed the title of Cartesians, I never can persuade myself, that the system of *innate ideas*, as conceived and adopted by *him*, was meant to give any sanction to the absurdities here treated by Voltaire with such just contempt. In no part of Descartes's works, as far as I have been able to discover, is the slightest ground given for this extraordinary account of his opinions. Nor was Descartes the first person who introduced this language. Long before the date of his works, it was in common use in England; and is to be found in a *Poem* of Sir John Davis, published four years before Descartes was born. (See Sect. XXVI. of *The Immortality of the Soul.*) The title of this section expressly asserts, That *there are innate ideas in the soul.*

In one of Descartes's letters, he enters into some explanations with respect to this part of his philosophy, which he complains had been very grossly misunderstood or misrepresented. To the following passage I have no doubt that Locke himself would have subscribed. It strikes myself as so very remarkable, that, in order to attract to it the attention of my readers, I shall submit it to their consideration in an English translation.

"When I said that the idea of God is innate in us, I never meant more than this, that Nature has endowed us with a faculty by which we may know God; but I have never either said or thought, that such ideas had an actual existence, or even that they were *species* distinct from the faculty of thinking. I will even go farther, and assert that nobody has kept at a greater distance than myself from all this trash of scholastic entities, insomuch that I could not help smiling when I read the numerous arguments which Regius has so industriously collected to show that infants have no actual knowledge of God while they remain in the womb. Although the idea of God is so imprinted on our minds, that every person has within himself the faculty of knowing him, it does not follow that there may not have been various individuals who have passed through life without ever making this idea a distinct object of apprehension; and, in truth, they who think they have an idea of a plurality of Gods, have no idea of God whatsoever." (Cartesii, *Epist.* Pars I. Epist. xcix.)

After reading this passage from Descartes, may I request of my readers to look back to the extracts in the beginning of this note, from Voltaire's letters? A remark of Montesquieu, occasioned

by some strictures hazarded by this lively but very superficial philosopher on the *Spirit of Laws*, is more peculiarly applicable to him when he ventures to pronounce judgment on metaphysical writers: "Quant à Voltaire, il a *trop d'esprit pour m'entendre;* tous les livres qu'il lit, il les fait, après quoi il approuve ou critique ce qu'il a fait." (*Lettre à M. l'Abbé de Guasco.*) The remark is applicable to other critics as well as to Voltaire.

The prevailing misapprehensions with respect to this, and some other principles of the Cartesian metaphysics, can only be accounted for by supposing, that the opinions of Descartes have been more frequently judged of from the glosses of his followers, than from his own works. It seems to have never been sufficiently known to his adversaries, either in France or in England, that, after his philosophy had become fashionable in Holland, a number of Dutch divines, whose opinions differed very widely from his, found it convenient to shelter their own errors under his established name; and that some of them went so far as to avail themselves of his authority in propagating tenets directly opposite to his declared sentiments. Hence a distinction of *the Cartesians* into the *genuine* and the *pseudo*-Cartesians; and hence an inconsistency in their representations of the metaphysical ideas of their master, which can only be cleared up by a reference (seldom thought of) to his own very concise and perspicuous text. (*Fabricii Bib. Gr.* lib. iii. cap. vi. p. 183. *Heinecc. El. Hist. Phil.* § cx.)

Many of the objections commonly urged against the *innate ideas* of Descartes are much more applicable to the *innate ideas* of Leibnitz, whose language concerning them is infinitely more hypothetical and unphilosophical; and sometimes approaches nearly to the enthusiastic theology of Plato and of Cudworth. Nothing in the works of Descartes bears any resemblance, in point of extravagance, to what follows: "Pulcherrima multa sunt Platonis dogmata, ... esse in divina mente mundum intelligibilem, quem ego quoque vocare soleo regionem idearum; objectum sapientiæ esse τὰ οντως οντα, substantias nempe simplices, quæ a me *monades* appellantur, et semel existentes semper perstant, πρωτα δικτικα της ζωης, id est Deum et Animas, et harum potissimas mentes, producta a Deo simulacra divinitatis....... Porro quævis mens, ut recte Plotinus, quendam in se mundum intelligibilem continet, imo mea sententia et hunc ipsum sensibilem sibi repræsentat....... Sunt in nobis *semina eorum*, quæ discimus, ideæ nempe, et quæ inde nascuntur, æternæ veritates..... Longe ergo præferendæ sunt Platonis *notitiæ innatæ*, quas *reminiscentiæ* nomine velavit, tabulæ rasæ Aristotelis et Lockii, aliorumque recentiorum, qui ἐξωτερικως philosophantur." (*Leib. Opera*, Tom. II. p. 223.)

Wild and visionary, however, as the foregoing propositions are, if the names of Gassendi and of Hobbes had been substituted instead of those of Aristotle and of Locke, I should have been disposed to subscribe implicitly to the judgment pronounced in the concluding sentence. The metaphysics of Plato, along with a considerable alloy of poetical fiction, has at least the merit of containing a large admixture of important and of ennobling truth; while that of Gassendi and of Hobbes, beside its inconsistency with facts attested, every moment, by our own consciousness, tends directly to level the rational faculties of man with the instincts of the brutes.

In the *Acta Eruditorum* for the year 1684, Leibnitz observes, that "in the case of things which we have never thought of, the *innate ideas* in our minds may be compared to the figure of Hercules in a block of marble." This seems to me to prove, that the difference between him and Locke was rather in appearance than in reality; and that, although he called those ideas *innate* which Locke was at pains to trace to sensation or to reflection, he would have readily granted, that our first knowledge of their existence was coëval with the first impressions made on our senses by external objects. That this was also the opinion of Descartes is still more evident; notwithstanding the ludicrous point of view in which Voltaire has attempted to exhibit this part of his system.

Note (E.) p. 19.

Mr Locke seems to have considered this use of the word *reflection* as peculiar to himself; but it is perfectly analogous to the *κινησεις κυκλικαι* of the Greek philosophers, and to various expressions which occur in the works of John Smith of Cambridge, and of Dr Cudworth. We find it in a *Poem on the Immortality of the Soul*, by Sir John Davis, Attorney-General to Queen Elizabeth. and probably it is to be met with in English publications of a still earlier date.

All things without which round about we see,
We seek to know, and have wherewith to do;
But that whereby we reason, live, and be,
Within ourselves we strangers are thereto.

Is it because the mind is like the eye,
Thro' which it gathers knowledge by degrees;
Whose rays *reflect* not, but spread outwardly;
Not seeing itself, when other things it sees?

No, doubtless; for the mind can backward cast
Upon herself her understanding light;
But she is so corrupt, and so defac'd,
As her own image doth herself affright.

As is the fable of the Lady fair,
Which for her lust was turn'd into a cow;
When thirsty, to a stream she did repair,
And saw herself transform'd, she wist not how:

At first she startles, then she stands amaz'd;
At last with terror she from hence doth fly,
And loathes the wat'ry glass wherein she gaz'd,
And shuns it still, altho' for thirst she die.

For even at first *reflection* she espies
Such strange chimeras, and such monsters there;
Such toys, such antics, and such vanities,
As she retires and shrinks for shame and fear.

I have quoted these verses, chiefly because I think it not improbable that they may have suggested to Gray the following very happy allusion in his fine Fragment *De Principiis Cogitandi*:

Qualis Hamadryadum quondam si forté sororum
Una, novos peragrans saltus, et devia rura
(Atque illam in viridi suadet procumbere ripa
Fontis pura quies, et opaci frigoris umbra);
Dum prona in latices speculi de margine pendet,
Mirata est subitam venienti occurrere Nympham
Mox eosdem, quos ipsa, artus, eadem ora gerentem
Unà inferre gradus, unà succedere sylvæ
Aspicit alludens; seseque agnoscit in undis:
Sic sensu interno rerum simulacra suarum
Mens ciet, et proprios observat conscia vultus.

Note (F.) p. 37.

The chief attacks made in England on Locke's *Essay*, during his own lifetime, were by Edward Stillingfleet, Bishop of Worcester; John Norris,[1] Rector of Bemerton; Henry Lee, B. D.; and the Reverend Mr Lowde (author of a *Discourse concerning the Nature of Man*). Of these four writers, the first is the only one whose objections to Locke are now at all remembered in the learned world; and for this distinction, Stillingfleet is solely indebted (I speak of him here merely as a metaphysician; for in some other departments of study, his merits are universally admitted) to the particular notice which Lock has condescended to take of him, in the Notes incorporated with the later editions of his *Essay*. The only circumstance which renders these Notes worthy of preservation, is the record they furnish of Locke's forbearance and courtesy, in managing a controversy carried on, upon the other side, with so much captiousness and asperity. An Irish Bishop, in a letter on this subject to Mr Molyneux, writes thus: "I read Mr Locke's letter to the Bishop of Worcester with great satisfaction, and am wholly of your opinion, that he has fairly laid the great bishop on his back, but it is with so much gentleness, as if he were afraid not only of hurting him, but even of spoiling or tumbling his clothes."

The work of Lee is entitled *Anti-scepticism*, or Notes upon each Chapter of Mr Locke's *Essay concerning Human Understanding*, with an explanation of all the particulars of which he treats, and in the same order. By Henry Lee, B. D. formerly Fellow of Emanuel College in Cambridge, now Rector of Tichmarsh in Northamptonshire. London, 1702, in folio.

The strictures of this author, which are often acute and sometimes just, are marked throughout with a fairness and candour rarely to be met with in controversial writers. It will appear remarkable to modern critics that he lays particular stress upon the charms of Locke's style, among the other excellencies which had conspired to recommend his work to public favour. "The celebrated author of the *Essay on Human Understanding* has all the advantages desirable to recommend it to the inquisitive genius of this age, an avowed pretence to new methods of discovering truth and improving learning; an unusual coherence in the several parts of his scheme; a singular clearness in his reasonings; and *above all*, a natural elegancy of style; an unaffected beauty in his expressions; a just proportion and tuneful cadence in all his periods." (See the *Epistle Dedicatory*)

Note (G.) p. 41.

For the information of some of my readers, it may be proper to observe, that the word *influx* came to be employed to denote the *action* of body and soul on each other, in consequence of a prevailing theory which supposed that this action was carried on by something intermediate (whether material or immaterial was not positively decided) *flowing* from the one substance to the other. It is in this sense that the word is understood by Leibnitz, when he states as an insurmountable objection to the theory of *influx*, that "it is impossible to conceive either material particles or immaterial qualities to pass from body to mind, or from mind to body."

Instead of the term *influx*, that of *influence* came gradually to be substituted by our English

[1] Of this person, who was a most ingenious and original thinker, I shall have occasion afterwards to speak.

writers; but the two words were originally synonymous, and were used indiscriminately as late as the time of Sir Matthew Hale. (See his *Primitive Origination of Mankind.*)

In Johnson's *Dictionary*, the primitive and radical meaning assigned to the word *influence* (which he considers as of French extraction) is "the power of the celestial aspects operating upon terrestrial bodies and affairs;" and in the *Encyclopædia* of Chambers, it is defined to be "a quality supposed to *flow* from the bodies of the stars, either with their heat or light, to which astrologers vainly attribute all the events which happen on the earth." To this astrological use of the word Milton had plainly a reference in that fine expression of his *L'Allegro*,

> "Store of ladies whose bright eyes
> "*Rain influence*."[1]

It is a circumstance worthy of notice, that a word thus originating in the dreams of astrologers and schoolmen, should now, in our language, be appropriated almost exclusively to politics. "Thus" (says Blackstone) "are the electors of one branch of the legislature secured from any undue *influence* from either of the other two, and from all external violence and compulsion; but the greatest danger is that in which themselves co-operate by the infamous practice of bribery and corruption." And again, "The crown has gradually and imperceptibly gained almost as much in *influence* as it has lost in prerogative."

In all these cases, there will be found at bottom one common idea, the existence of some secret and mysterious connection between two things, of which connection it is conceived to be impossible or unwise to trace what Bacon calls the *latens processus*.

Note (H.) p. 43.

After these quotations from Locke, added to those which I have already produced from the same work, the reader may judge of the injustice done to him by Leibnitz, in the first sentence of his correspondence with Clarke.

"Il semble que la religion naturelle même s'affoiblit extrêmement. Plusieurs font les ames corporelles; d'autres font Dieu lui-même corporel.

"M. Locke et ses sectateurs, *doutent* au moins, si les ames ne sont matérielles, et naturellement perissables."

Dr Clarke, in his reply to this charge, admits that "*some* parts of Locke's writings may justly be suspected as intimating his doubts whether the soul be immaterial or no, but herein (he adds) he has been followed only by some Materialists, enemies of the mathematical principles of philosophy; and who approve little or nothing in Mr Locke's writings, but his errors."

To those who have studied with care the *whole* writings of Locke, the *errors* here alluded to will appear in a very venial light when compared with the general spirit of his philosophy. Nor can I forbear to remark farther on this occasion, that supposing Locke's *doubts* concerning the immateriality of the soul to have been as real as Clarke seems to have suspected, this very circumstance would only reflect the greater lustre on the soundness of his *logical* views concerning the proper method of studying the mind;—in the prosecution of which study, he has adhered much more systematically

[1] The explanation of the word *Influence*, given in the *Dictionary* of the French Academy, accords perfectly with the tenor of the above remarks. "Vertu qui, suivant les Astrologues, *découle* des astres sur les corps sublunaires."

than either Descartes or Leibnitz, to the exercises of *reflection*, as the sole medium for ascertaining the internal phenomena; describing, at the same time, these phenomena in the simplest and most rigorous terms which our language affords, and avoiding, in a far greater degree than any of his predecessors, any attempt to explain them by analogies borrowed from the perceptions of the external senses.

I before observed, that Leibnitz greatly underrated Locke as a metaphysician. It is with regret I have now to mention, that Locke has by no means done justice to the splendid talents and matchless erudition of Leibnitz. In a letter to his friend Mr Molyneux, dated in 1697, he expresses himself thus: "I see you and I agree pretty well concerning Mr Leibnitz; and this sort of fiddling makes me hardly avoid thinking, that he is not that very great man as has been talked of him." And in another letter, written in the same year to the same correspondent, after referring to one of Leibnitz's Memoirs in the *Acta Eruditorum* (De primæ Philosophiæ Emendatione), he adds, "From whence I only draw this inference, that even *great parts* will *not master* any subject without great thinking, and that even the largest minds have but narrow swallows."

Let me add, that in my quotations from English writers, I adhere scrupulously to their own phraseology, in order to bring under the eye of my readers, specimens of English composition at different periods of our history. I must request their attention to this circumstance, as some expressions in the former part of this Dissertation, which have been censured as Scotticisms, occur in Extracts from authors who, in all probability, never visited this side of the Tweed.

Note (I.) p. 51.

After studying, with all possible diligence, what Leibnitz has said of his *monads* in different parts of his works, I find myself quite incompetent to annex any precise idea to the word as he has employed it. I shall, therefore, aim at nothing more in this note, but to collect, into as small a compass as I can, some of his most intelligible attempts to explain its meaning.

"A substance is a thing capable of action. It is simple or compounded. A simple substance is that which has no parts. A compound substance is an aggregate of simple substances or of *monads*.

"Compounded substances, or bodies, are multitudes. Simple substances, lives, souls, spirits, are units.[1] Such simple substances must exist every where; for without simple substances there could be no compounded ones. All nature therefore is full of life." (Tom. II. p. 32.)

"*Monads*, having no parts, are neither extended, figured, nor divisible. They are the real *atoms* of nature, or, in other words, the elements of things." (Tom. II. p. 20.)

(It must not, however, be imagined, that the *monads* of Leibnitz have any resemblance to what are commonly called *atoms* by philosophers. On the contrary, he says expressly, that "*monads* are *not* atoms of *matter*, but atoms of *substances*;—real units, which are the first principles in the composition of things, and the last elements in the analysis of substances;—of which principles or elements, what we call *bodies* are only the *phenomena*.")—(Tom. II. pp. 53. 325.)

In another passage we are told, that "a *monad* is not a *material* but a *formal* atom, it being impossible for a thing to be at once material, and possessed of a real unity and indivisibility. It is necessary, therefore" (says Leibnitz), "to revive the obsolete doctrine of *substantial forms* (the es-

[1] "Les substances simples, les vies, lese ames, les esprits, sont des unités."

sence of which consists in *force*), separating it, however, from the various abuses to which it is liable."—(*Ibid.* p. 50.)

"Every *monad* is a living mirror, representing the universe, according to its particular point of view, and subject to as regular laws as the universe itself."

"Every *monad*, with a particular body, makes a living substance."

"The knowledge of every *soul* (*ame*) extends to infinity, and to all things; but this knowledge is confused. As a person walking on the margin of the sea, and listening to its roar, hears the noise of each individual wave of which the whole noise is made up, but without being able to distinguish one sound from another, in like manner, our confused perceptions are the result of the impressions made upon us by the whole universe. The case (he adds) is the same with each *monad*."

"As for the reasonable soul or mind (*l'esprit*), there is something in it more than in the *monads*, or even than in those souls which are simple. It is not only a mirror of the universe of created things, but an image of the Deity. Such minds are capable of reflected acts, and of conceiving what is meant by the words *I*, *substance*, *monad*, *soul*, *mind*; in a word, of conceiving *things and truths* unconnected with matter; and it is this which renders us capable of science and of demonstrative reasoning.

"What becomes of these *souls* or *forms*, on the death of the animal? There is no alternative (replies Leibnitz) but to conclude, that not only the soul is preserved, but that the *animal also with its organical machine* continues to exist, although the destruction of its grosser parts has reduced it to a smallness as invisible to our eyes as it was before the moment of conception. Thus neither animals nor souls perish at death; nor is there such a thing as *death*, if that word be understood with rigorous and metaphysical accuracy. The soul never quits completely the body with which it is united, nor does it pass from one body into another with which it had no connection before, a *metamorphosis* takes place, but there is no *metempsychosis*."—(Tom. II. pp. 51, 52.)

On this part of the Leibnitzian system, D'Alembert remarks, that it proves nothing more than that the author had perceived better than any of his predecessors, the impossibility of forming a distinct idea of the nature of *matter*; a subject, however (D'Alembert adds), on which the theory of the monads does not seem calculated to throw much light. I would rather say (without altogether denying the justness of D'Alembert's criticism), that this theory took its rise from the author's vain desire to explain the nature of *forces*; in consequence of which he suffers himself perpetually to be led astray from those *sensible effects* which are exclusively the proper objects of *physics*, into conjectures concerning their *efficient causes*, which are altogether placed beyond the reach of our research.

Note (K.) p. 55.

The *metaphysical* argument advanced by the Leibnitzians in proof of the *law of continuity* has never appeared to me to be satisfactory. "If a body at rest (it has been said) begins, *per saltum*, to move with any finite velocity, then this body must be at the same indivisible instant in two different states, that of rest and of motion, which is impossible."[1]

[1] "Si toto tempore (says Father Boscovich, speaking of the Law of Continuity in the Collision of Bodies) ante contactum subsequentis corporis superficies antecedens habuit 12 gradus velocitatis, et sequenti 9, saltu facto momentaneo ipso initio contactus; in

As this reasoning, though it relates to a *physical fact*, is itself wholly of a *metaphysical* nature, and as the inference deduced from it has been generalized into a LAW, supposed to extend to all the various branches of human knowledge, it is not altogether foreign to our present subject briefly to consider how far it is demonstratively conclusive, in this simplest of all its possible applications

On the above argument, then, I would remark, 1. That the ideas both of *rest* and of *motion*, as well as the more general idea conveyed by the word *state*, all of them necessarily involve the idea of *time* or *duration*; and, consequently, a body cannot be said to be in a *state* either of rest or of motion, at an *indivisible* instant. Whether the body be supposed (as in the case of motion) to *change* its place from one instant to another; or to *continue* (as in that of rest) for an instant in the same place, the idea of some finite portion of time will, on the slightest reflection, be found to enter as an essential element into our conception of the physical fact.

2. Although it certainly would imply a contradiction to suppose a body to be in two different *states* at the same instant, there does not appear to be any inconsistency in asserting that an indivisible instant may form the limit between a state of rest and a state of motion. Suppose one half of this page to be painted white, and the other black, it might, I apprehend, be said with the most rigorous propriety, that the transition from the one colour to the other was made *per saltum*; nor do I think it would be regarded as a valid objection to this phraseology, to represent it as one of its implied consequences, that the mathematical line which forms their common limit, must at once be both black and white. It seems to me quite impossible to elude the force of this reasoning, without having recourse to the existence of something intermediate between *rest* and *motion*, which does not partake of the nature of either.

Is it conceivable that a body can exist in any *state* which does not fall under one or other of the two predicaments, rest or motion? If this question should be answered in the negative, will it not follow that the transition from one of these *states* to the other must, of necessity, be made *per saltum*, and must consequently violate the supposed law of continuity? Indeed, if such a law existed, how could a body at rest *begin* to move, or a body in motion come to a state of rest?

But farther, when it is said that "it is impossible for a body to have its state changed from motion to rest, or from rest to motion, without passing through all the intermediate degrees of velocity," what are we to understand by the *intermediate degrees of velocity between rest and motion*? Is not *every* velocity, how small soever, a *finite* velocity; and does it not differ as essentially from a state of rest, as the velocity of light?

It is observed by Mr Playfair (*Second Dissertation*, Part I. p. 70), that Galileo was the first who maintained the existence of the *law of continuity*, and who made use of it as a principle in his reasonings on the phenomena of motion. Mr Playfair, however, with his usual discrimination and correctness, ranks this among the *mechanical* discoveries of Galileo. Indeed, it does not appear that it was at all regarded by Galileo (as it avowedly was by Leibnitz) in the light of a metaphysical

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ipso momento ea tempora dirimente debuissent habere et 12 et 9 simul, quod est absurdum. Duas enim velocitates simul habere corpus non potest."—*Theoria Phil. Nat. &c.*

Boscovich, however, it is to be observed, admits the existence of the Law of Continuity in the phenomena of Motion alone (§ 143), and rejects it altogether in things co-existent with each other (§ 142). In other cases, he says, Nature does not observe the Law of Continuity with mathematical accuracy, but only *affects it*; by which expression he seems to mean, that, where she is guilty of a *saltus*, she aims at making it as moderate as possible. The expression is certainly deficient in metaphysical precision; but it is not unworthy of attention, inasmuch as it affords a proof, that Boscovich did not (with the Leibnitzians) conceive Nature, or the Author of Nature, as obeying an *irresistible necessity* in observing or not observing the Law of Continuity.

and necessary *law*, which could not by any possibility be violated in any of the phenomena of motion. It was probably first suggested to him by the diagram which he employed to *demonstrate*, or rather to *illustrate*, the uniformly accelerated motion of falling bodies;[1] and the numberless and beautiful exemplifications of the same law which occur in *pure geometry*, sufficiently account for the disposition which so many Mathematicians have shown to extend it to all those branches of physics which admit of a mathematical consideration.

My late illustrious friend, who, to his many other great and amiable qualities, added the most perfect fairness and candour in his inquiries after truth, has, in the posthumous fragment which has already appeared in this *Supplement*, expressed himself with considerably greater scepticism concerning the law of continuity, than in his *Outlines of Natural Philosophy*. In that work he pronounced the metaphysical argument, employed by Leibnitz to prove its *necessity*, " to be conclusive." (Sect. VI. § 99, b.) In the second part of his *Dissertation* (p. 34), he writes thus on the same subject:

" Leibnitz considered this principle as known *a priori*, because, if any *saltus* were to take place, that is, if any change were to happen without the intervention of time, the thing changed must be in two different conditions at the same individual instant, which is obviously impossible. Whether this reasoning be quite satisfactory or no, the conformity of the law to the facts generally observed cannot but entitle it to great authority in judging of the explanations and theories of natural phenomena."

The phrase, *Law of Continuity*, occurs repeatedly in the course of the correspondence between Leibnitz and John Bernouilli, and appears to have been *first* used by Leibnitz himself. The following passage contains some interesting particulars concerning the history of this law: " *Lex Continuitatis*, cum usque adeo sit rationi et naturæ consentanea, et usum habeat tam late patentem, mirum tamen est eam a nemine (quantum recorder) antea adhibitam fuisse. Mentionem ejus aliquam feceram olim in Novellis Reipublicæ Literariæ (Juillet 1687, p. 744), occasione collatiunculæ cum Malebranchio, qui ideo meis considerationibus persuasus, suam de legibus motus in Inquisitione Veritatis expositam doctrinam postea mutavit; quod brevi libello edito testatus est, in quo ingenue occasionem mutationis exponit. Sed tamen paullo promptior, quam par erat, fuit in novis legibus constituendis in eodem libello, antequam mecum communicasset; nec tantum in veritatem, sed etiam in illam ipsam Legem Continuitatis, etsi minus aperte, denuo tamen impegit; quod nolui viro optimo objicere, ne viderer ejus existimationi detrahere velle.—*Epist.* Leibnit. ad Joh. Bernouilli, 1697.

From one of John Bernouilli's letters to Leibnitz, it would appear that he had himself a conviction of the truth of this law, before he had any communication with Leibnitz upon the subject. " Placet tuum criterium pro examinandis regulis motuum, quod *legem continuitatis* vocas; est enim per se evidens, et velut a natura nobis inditum, quod evanescente inæqualitate hypothesium, evanescere quoque debeant inæqualitates eventuum. Hinc multoties non satis mirari potui, qui

[1] Descartes seems, from his correspondence with Mersenne, to have been much puzzled with Galileo's reasonings concerning the descent of falling bodies; and in alluding to it, has, on different occasions, expressed himself with an indecision and inconsistency of which few instances occur in his works. (Vide *Cartesii Epist.* Pars II. Epist. xxxiv. xxxv. xxxvii. xci.) His doubts on this point will appear less surprising, if compared with a passage in the article *Méchanique* in D'Alembert's *Elémens de Philosophie.* " Tous les philosophes paroissent convenir, que la vitesse avec laquelle les corps qui tombent commencent à se mouvoir est absolument nulle," &c. &c. (See his *Melanges*, Tom. IV. p. 219, 220.)

fieri potuerit, ut tam incongruas, tam absonas, et tam manifeste inter se pugnantes regulas excepta sola prima, potuerit condere Cartesius, vir alias summi ingenii. Mihi videtur vel ab infante falsitatem illarum pappari posse, ea quod ubique saltus ille, naturæ adeo inimicus, manifeste nimis elucet." (*Epist.* Bernouilli ad Leib. 1696. Vide Leibnitzii et Jo. Bernouilli *Comm. Epist.* 2 vols. 4to, Lausannæ et Genevæ, 1745.)

Note (L.) p. 56.

Mais il restoit encore la plus grande question, de ce que ces âmes ou ces formes deviennent par la mort de l'animal, ou par la destruction de l'individu de la substance organisé. Et c'est ce qui embarrasse le plus; d'autant qu'il paroit peu raisonnable que les âmes restent inutilement dans un chaos de matière confuse. Cela m'a fait juger enfin qu'il n'y avoit qu'un seul parti raisonnable à prendre; et c'est celui de la conservation non seulement de l'âme, mais encore de l'animal même, et de la machine organique; quoique la destruction des parties grossières l'ait reduit à une petitesse qui n'echappe pas moins à nos sens que celle ou il etoit avant que de naître. (Leib. *Op.* Tom. II. p. 51.)

. . . . Des personnes fort exactes aux expériences se sont deja aperçues de nôtre tems,[1] qu'on peut douter, si jamais un animal tout à fait nouveau est produit, et si les animaux tout en vie ne sont deja en petit avant la conception dans les semences aussi bien que les plantes. Cette doctrine etant posée, il sera raisonnable de juger, que ce qui ne commence pas de vivre ne cesse pas de vivre non plus; et que la mort, comme la generation, n'est que la transformation du même animal qui est tantôt augmenté, et tantôt diminué. (*Ibid.* pp. 42, 43.)

. . . . Et puisqu' ainsi il n'y a point de première naissance ni de génération entièrement nouvelle de l'animal, il s'ensuit qu'il n'y en aura point d'extinction finale, ni de mort entière prise à la rigueur métaphysique; et que, par consequent, au lieu de la transmigration des âmes, il n'y a qu'une transformation d'un même animal, selon que les organes sont pliés différément, et plus ou moins développés. (*Ibid.* p. 52.)

Quant à la Métempsycose, je crois que l'ordre ne l'admet point; il veut que tout soit explicable distinctement, et que rien ne se fasse par saut. Mais le passage de l'âme d'un corps dans l'autre seroit un saut étrange et inexplicable. Il se fait toujours dans l'animal ce qui se fait presentement: C'est que le corps est dans un changement continuel, comme un fleuve, et ce que nous appellons génération ou mort, n'est qu'un changement plus grand et plus prompt qu'à l'ordinaire, tel que seroit le saut ou la cataracte d'une rivière. Mais ces sauts ne sont pas absolus et tels que je desaprouve; comme seroit celui d'un corps qui iroit d'un lieu à un autre sans passer par le milieu. *Et de tels sauts ne sont pas seulement défendus dans les mouvemens, mais encore dans tout ordre des choses ou des vérités.*—The sentences which follow afford a proof of what I have elsewhere remarked, how much the mind of Leibnitz was misled, in the whole of this metaphysical theory, by habits of thinking formed in early life, amidst the hypothetical abstractions of pure geometry; a prejudice (or *idol of the* mathematical *den*) to which the most important errors of his philosophy might, without much difficulty, be traced.—" Or comme dans une ligne de géométrie il y a certains points distingués, qu'on appelle sommets, points d'inflexion, points de rebroussement, ou autrement; et comme il y en a des lignes qui en ont une infinité, c'est ainsi qu'il faut concevoir

[1] The experiments here referred to are the observations of Swammerdam, Malpighi, and Lewenhoeck.

dans la vie d'un animal ou d'une personne les tems d'un changement extraordinaire, qui ne laissent pas d'être dans la regle genérale ; de même que les points distingués dans la courbe se peuvent determiner par sa nature generale ou son equation. "On peut toujours dire d'un animal *c'est tout comme ici*, la difference n'est que du plus ou moins." (Tom. V. p 18.)

Note (M.) p 60.

The praise which I have bestowed on this Memoir renders it necessary for me to take some notice of a very exceptionable proposition which is laid down in the first paragraph, as a fundamental maxim,—that "all proper names were at first Appellatives;" a proposition so completely at variance with the commonly received opinions among later philosophers, that it seems an object of some curiosity to inquire, how far it is entitled to plead in its favour the authority of Leibnitz Since the writings of Condillac and of Smith, it has, so far as I know, been universally acknowledged, that, if there be any one truth in the *Theoretical History* of Language, which we are entitled to assume as an incontrovertible fact, it is the direct contrary of the above proposition In deed, to assert that all proper names were at first appellatives, would appear to be nearly an absurdity of the same kind as to maintain, that *classes* of objects existed before *individual* objects had been brought into being.

When Leibnitz, however, comes to explain his idea more fully, we find it to be something very different from what his words literally imply; and to amount only to the trite and indisputable observation, That, in simple and primitive languages, all proper names (such as the names of persons, mountains, places of residence, &c.) are descriptive or significant of certain prominent and characteristical features, distinguishing them from other objects of the same class,—a fact, of which a large proportion of the surnames still in use all over Europe, as well as the names of mountains, villages, and rivers, when traced to their primitive roots, afford numerous and well known exemplifications.

Not that the proposition, even when thus explained, can be assumed as a general maxim It holds, indeed, in many cases, as the Celtic and the Saxon languages abundantly testify in our own island; but it is true only under certain limitations, and it is perfectly consistent with the doctrine delivered on this subject by the greater part of philologers for the last fifty years

In the history of language, nothing is more remarkable, than the aversion of men to coin words out of unmeaning and arbitrary sounds; and their eagerness to avail themselves of the stores already in their possession, in order to give utterance to their thoughts on the new topics which the gradual extension of their experience is continually bringing within the circle of their knowledge Hence Metaphors, and other figures of speech; and hence the various changes which words undergo, in the way of amplification, diminution, composition, and the other transformations of elementary terms which fall under the notice of the etymologist. Were it not, indeed, for this strong and universal bias of our nature, the vocabulary of every language would, in process of time, become so expansive and unwieldy, as to render the acquisition of one's mother tongue a task of immense difficulty; and the acquisition of a dead or foreign tongue next to impossible It is needless to observe, how immensely these tasks are facilitated by that etymological system which runs, more or less, through every language; and which everywhere proceeds on certain analogical principles, which it is the business of the practical grammarian to reduce to general rules, for the sake of those who wish to speak or to write it with correctness.

In attempting thus to trace backwards the steps of the mind towards the commencement of its progress, it is evident, that we must at last arrive at a set of elementary and primitive roots, of which no account can be given, but the arbitrary choice of those who first happened to employ them. It is to this *first* stage in the infancy of language, that Mr Smith's remarks obviously relate; whereas the proposition of Leibnitz, which gave occasion to this note, as obviously relates to its subsequent stages, when the language is beginning to assume somewhat of a regular form, by compositions and other modifications of the materials previously collected.

From these slight hints it may be inferred, 1st, That the proposition of Leibnitz, although it may seem, from the very inaccurate and equivocal terms in which it is expressed, to stand in direct opposition to the doctrine of Smith, was really meant by the author to state a fact totally unconnected with the question under Smith's consideration. 2dly, That even in the sense in which it was understood by the author, it fails entirely, when extended to that *first* stage in the infancy of language, to which the introductory paragraphs in Mr Smith's discourse are exclusively confined.

Note (N.) p. 62.

" Je viens de reçevoir une lettre d'un Prince Regnant de l'Empire, ou S. A. me marque avoir vu deux fois ce printems à la derniere foire de Leipsig et examiné aveo soin, un chien qui parle. Ce chien a prononcé distinctement plus de trente mots, repondant même assez à propos à son maître : il a aussi prononcé tout l'alphabet excepté les lettres, m, n, x." (Leib. *Opera*. Tom. V. p. 72.)

Thus far the fact rests upon the authority of the German prince alone. But from a passage in the *History of the Academy of Sciences*, for the year 1706, it appears that Leibnitz had himself seen and heard the dog. What follows is transcribed from a report of the Academy upon a letter from Leibnitz to the Abbé de St Pierre, giving the details of this extraordinary occurrence.

" Sans un garant tel que M. Leibnitz, temoin oculaire, nous n'aurions pas la hardiesse de rapporter, qu'auprès de Zeitz dans la Misnie, il y a un chien qui parle. C'est un chien de Paysan, d'une figure des plus communes, et de grandeur mediocre. Un jeune enfant lui entendit pousser quelques sons qu'il crut ressembler à des mots Allemands, et sur cela se mit en tête de lui apprendre à parler. Le maitre, qui n'avoit rien de mieux à faire, n'y épargna pas le tems ni ses peines, et heureusement le disciple avoit des dispositions qu'il eut été difficile de trouver dans un autre. Enfin, au bout de quelques années, le chien sçut prononcer environ une trentaine de mots : de ce nombre sont *The*, *Caffé*, *Chocolat*, *Assemblée*, mots François, qui ont passé dans l'Allemand tels qu'ils sont. Il est à remarquer, que le chien avoit bien trois ans quand il fut mis à l'ecole. Il ne parle que par écho, c'est à dire, après que son maître a prononcé un mot; et il semble, qu'il ne repète que par force et malgré lui, quoiqu'on ne le maltraite pas. Encore une fois, M. Leibnitz l'a vu et entendu."

(Exposé d'une lettre de M. Leibnitz à l'Abbé de St Pierre sur un chien qui parle.) " Cet exposé de la lettre de M. Leibnitz se trouve dans l'Histoire de l'Academie des Sciences, Année 1706. Ce sont les Auteurs de l'Histoire de l'Academie qui parlent." (Leib. *Opera*, Vol. II. p. 180. P. II.)

May not all these circumstances of the above story be accounted for, by supposing the master of the dog to have possessed that peculiar species of imitative power which is called *Ventriloquism?* Mathews, I have no doubt, would find little difficulty in managing such a deception, so as to impose on the senses of any person who had never before witnessed any exhibition of the same kind.

NOTE (O.) p. 62.

WHEN I speak in favourable terms of the *Philosophical Spirit*, I hope none of my readers will confound it with the spirit of that false philosophy, which, by unhinging every rational principle of belief, seldom fails to unite in the same characters the extremes of scepticism and of credulity. it is a very remarkable fact, that the same period of the eighteenth century, and the same part of Europe which were most distinguished by the triumphs of Atheism and Materialism, were also distinguished by a greater number of visionaries and impostors than had ever appeared before, since the revival of letters. Nor were these follies confined to persons of little education. They extended to men of the highest rank, and to many individuals of distinguished talents. Of this the most satisfactory proofs might be produced; but I have room here only for one short quotation It is from the pen of the Duc de Levis, and relates to the celebrated Mareschal de Richelieu, on whom Voltaire has lavished so much of his flattery. "Ce dont je suis positivement certain, c'est que cet homme spirituel (Le Mareschal de Richelieu) étoit superstitieux, et qu'il croyoit aux prédictions des astrologues et autres sottises de cet espèce. Je l'ai vu refusant à Versailles d'aller faire sa cour au fils ainé de Louis XVI. en disant serieusement, *qu'il savoit* que cet enfant n'etoit point destiné au trône. Cette crédulité superstitieuse, générale pendant la ligue, étoit encore très commune sous la régence lorsque le Duc de Richelieu entra dans le monde; par la plus bizarre des inconséquences, elle s'allioit très bien avec la plus grande impiété, et la plupart des materialistes croyoient aux *esprits*; aujourd'hui, ce genre de folie est très rare; mais beaucoup de gens. qui se moquent des astrologues, croient à des prédictions d'une autre espece." (*Souvenirs et Portraits*, par M. de Levis, à Paris, 1813.)

Some extraordinary facts of the same kind are mentioned in the *Memoirs of the Marquis de Bouillé*. According to him, Frederic the Great himself was not free from this sort of superstition.

NOTE (P.) p. 63.

THE following estimate of Leibnitz, considered in comparison with his most distinguished contemporaries, approaches, on the whole, very nearly to the truth; although some doubts may be entained about the justness of the decision in the last clause of the sentence. "Leibnitz, aussi hardi que Descartes aussi subtil que Bayle, peutêtre moins profond que Newton, et moins sage que Locke, mais seul universel entre tous ces grand hommes, paroit avoir embrassé le domaine de la raison dans toute son étendue, et avoir contribué le plus à répandre cet esprit philosophique que fait aujourd'hui la gloire de notre siècle." (Bailly, *Eloge de Leibnitz.*)

I have mentioned in the text only a part of the learned labours of Leibnitz. It remains to be added, that he wrote also on various subjects connected with chemistry, medicine, botany, and natural history; on the philosophy and language of the Chinese; and on numberless other topics of subordinate importance. The philological discussions and etymological collections, which occupy so large a space among his works, would (even if he had produced nothing else) have been no inconsiderable memorials of the activity and industry of his mind.

Manifold and heterogeneous as these pursuits may at first appear, it is not difficult to trace the

thread by which his curiosity was led from one of them to another. I have already remarked a connection of the same sort between his different metaphysical and theological researches; and it may not be altogether uninteresting to extend the observation to some of the subjects enumerated in the foregoing paragraph.

The studies by which he first distinguished himself in the learned world (I pass over that of jurisprudence,[1] which was imposed on him by the profession for which he was destined) were directed to the antiquities of his own country; and more particularly to those connected with the history of the House of Brunswick. With this view he ransacked, with an unexampled industry, the libraries, monasteries, and other archives, both of Germany and of Italy; employing in this ungrateful drudgery several of the best and most precious years of his life. Mortified, however, to find how narrow the limits are, within which the range of written records is confined, he struck out for himself and his successors a new and unexpected light, to guide them through the seemingly hopeless darkness of remote ages. This light was the study of etymology, and of the affinities of different tongues in their primitive roots;—a light at first faint and glimmering, but which, since his time, has continued to increase in brightness, and is likely to do so more and more as the world grows older. It is pleasing to see his curiosity on this subject expand, from the names of the towns and rivers and mountains in his neighbourhood, till it reached to China and other regions in the East; leading him, in the last result, to some general conclusions concerning the origin of the different tribes of our species, approximating very nearly to those which have since been drawn from a much more extensive range of *data* by Sir William Jones, and other philologers of the same school.

As an additional light for illustrating the antiquities of Germany, he had recourse to natural history; examining, with a scientific eye, the shells and other marine bodies everywhere to be found in Europe, and the impressions of plants and fishes (some of them unknown in this part of the world) which are distinctly legible, even by the unlettered observer, on many of our fossils. In entering upon this research, as well as on the former, he seems to have had a view to Germany alone; on the state of which (he tells us), prior to all historical documents, it was his purpose to prefix a discourse to his History of the House of Brunswick. But his imagination soon took a bolder flight, and gave birth to his *Protogæa*;—a dissertation which (to use his own words) had for its object "to ascertain the original face of the earth, and to collect the vestiges of its earliest history from the monuments which nature herself has left of her successive operations on its surface." It is a work, which, wild and extravagant as it may now be regarded, is spoken of by Buffon with much respect; and is considered by Cuvier as the ground-work of Buffon's own system on the same subject.

In the connection which I have now pointed out between the Historical, the Philological, and the Geological speculations of Leibnitz, Helvetius might have fancied that he saw a new exemplification of *the law of continuity;* but the true light in which it ought to be viewed, is as a faithful picture of a philosophical mind emancipating itself from the trammels of local and conventional details, and gradually rising from subject to subject, till it embraces in its survey those nobler inquiries which, sooner or later, will be equally interesting to every portion of the human race.[2]

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[1] Bailly, in his *Eloge on Leibnitz*, speaks of him in terms of the most enthusiastic praise, as a philosophical jurist, and as a man fitted to become the legislator of the human race. To me, I must own, it appears, that there is no part of his writings in which he discovers less of his characteristical originality, than where he professes to treat of the law of nature. On these occasions, how inferior does he appear to Grotius, not to speak of Montesquieu and his disciples!

[2] In the above note, I have said nothing of Leibnitz's project of a philosophical language, founded on an alphabet of Human

NOTE (Q.) p. 70.

Of Locke's affectionate regard for Collins, notwithstanding the contrariety of their opinions on some questions of the highest moment, there exist many proofs in his letters, published by M. Des Maizeaux. In one of these, the following passage is remarkable. It is dated from Oates in Essex, 1703, about a year before Locke's death.

"You complain of a great many defects; and that very complaint is the highest recommendation I could desire to make me love and esteem you, and desire your friendship. And if I were now setting out in the world, I should think it my great happiness to have such a companion as you, who had a true relish for truth; would in earnest seek it with me; from whom I might receive it undisguised; and to whom I might communicate what I thought true freely. Believe it, my good friend, to love truth for truth's sake, in the principal part of human perfection in this world, and the seed-plot of all other virtues; and, if I mistake not, you have as much of it as ever I met with in any body. What, then, is there wanting to make you equal to the best; a friend for any one to be proud of?" ...... The whole of Locke's letters to Collins are highly interesting and curious; more particularly *that* which he desired to be delivered to him after his own death. From the general tenor of these letters, it may be inferred, that Collins had never let Locke fully into the secret of those pernicious opinions which he was afterwards at so much pains to disseminate.

NOTE (R.) p. 72.

In addition to the account of Spinoza given in Bayle, some interesting particulars of his history may be learnt from a small volume, entitled, *La Vie de B. de Spinoza, Tirée des ecrits de ce Fameux Philosophe, et du temoignage de plusieurs personnes dignes de foi, qui l'ont connu particulièrement: par Jean Colerus, Ministre de l'Eglise Lutherienne de la Haye.* 1706.[1] The book is evidently written by a man altogether unfit to appreciate the merits or demerits of Spinoza as an author; but it is not without some value to those who delight in the study of human character, as it supplies some chasms in the narrative of Bayle, and has every appearance of the most perfect impartiality and candour.

According to this account, Spinoza was a person of the most quiet and inoffensive manners; of singular temperance and moderation in his passions; contented and happy with an income which barely supplied him with the necessaries of life; and of too independent a spirit to accept of any addition to it, either from the favour of princes, or the liberality of his friends. In conformity to

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Thoughts, as he has nowhere given us any hint of the principles on which he intended to proceed in its formation, although he has frequently alluded to the practicability of such an invention in terms of extraordinary confidence. (For some remarks on these passages in his works, see *Philosophy of the Human Mind*, Vol. II. pp. 143, *et seq.*) In some of Leibnitz's expressions on this subject, there is a striking resemblance to those of Descartes in one of his letters. (See the preliminary discourse prefixed to the Abbé Emery's *Pensées de Descartes*, p. xiv. *et seq.*)

In the ingenious essay of Michaelis *On the Influence of Opinions on Language, and of Language on Opinions* (which obtained the prize from the Royal Society of Berlin in 1759), there are some very acute and judicious reflections on the impossibility of carrying into effect, with any advantage, such a project as these philosophers had in view. The author's argument on this point seems to me decisive, in the present state of human knowledge; but who can pretend to fix a limit to the possible attainments of our posterity!

[1] The life of Spinoza by Colerus, with some other curious pieces on the same subject, is reprinted in the complete edition of Spinoza's Works, published at Jena, in 1802

the law, and to the customs of his ancestors (which he adhered to, when he thought them not unreasonable, even when under the sentence of excommunication), he resolved to learn some mechanical trade; and fortunately selected that of grinding optical glasses, in which he acquired so much dexterity, that it furnished him with what he conceived to be a sufficient maintenance. He acquired also enough of the art of designing, to produce good portraits in chalk and china-ink, of some distinguished persons.

For the last five years of his life he lodged in the house of a respectable and religious family, who were tenderly attached to him, and from whom his biographer collected various interesting anecdotes. All of them are highly creditable to his private character, and more particularly show how courteous and amiable he must have been in his intercourse with his inferiors. In a bill presented for payment after his death, he is styled by Abraham Keveling, his barber-surgeon, *Benedict Spinoza, of blessed memory;* and the same compliment is paid to him by the tradesman who furnished gloves to the mourners at his funeral.

These particulars are the more deserving of notice, as they rest on the authority of a very zealous member of the Lutheran communion, and coincide exactly with the account given of Spinoza by the learned and candid Mosheim. "This man (says he) observed, in his conduct, the rules of wisdom and probity much better than many who profess themselves Christians; nor did he ever endeavour to pervert the sentiments or to corrupt the morals of those with whom he lived; or to inspire, in his discourse, a contempt of religion or virtue." . . . .(*Eccles. History*, translated by Dr Maclaine, Vol. IV. p. 252.)

Among the various circumstances connected with Spinoza's domestic habits, Colerus mentions one very trifling singularity, which appears to me to throw a strong light on his general character, and to furnish some apology for his eccentricities as an author. The extreme feebleness of his constitution (for he was consumptive from the age of 20) having unfitted him for the enjoyment of convivial pleasures, he spent the greater part of the day in his chamber alone: but when fatigued with study, he would sometimes join the family-party below, and take a part in their conversation, however insignificant its subject might be. One of the amusements with which he was accustomed to unbend his mind, was that of entangling flies in a spider's web, or of setting spiders a-fighting with each other; on which occasions (it is added) he would observe their combats with so much interest, that it was not unusual for him to be seized with immoderate fits of laughter. Does not this slight *trait* indicate very decidedly a tendency to insanity; a supposition by no means incompatible (as will be readily admitted by all who have paid any attention to the phenomena of madness) with that logical *acumen* which is so conspicuous in some of his writings.

His irreligious principles he is supposed to have adopted, in the first instance, from his Latin preceptor Vander Ende, a physician and classical scholar of some eminence; but it is much more probable, that his chief school of atheism was the synagogue of Amsterdam; where, without any breach of charity, a large proportion of the more opulent class of the assembly may be reasonably presumed to belong to the ancient sect of *Sadducees*.* (This is, I presume, the idea of Heineccius in the following passage; "Quamvis Spinoza Cartesii principia methodo mathematicâ demonstrata dederit; Pantheismum tamen ille non ex Cartesio didicit, sed *domi habuit, quos sequeretur*." In proof of this, he refers to a book entitled *Spinozismus in Judaismo*, by Waechterus.) The blasphemous curses pronounced upon him in the sentence of excommunication were not well calculated to recall him to the faith of his ancestors: and when combined with his early and hereditary

prejudices against Christianity, may go far to account for the indiscriminate war which he afterwards waged against priests of all denominations.

The ruling passion of Spinoza seems to have been the love of fame. "It is owned (says Bayle) that he had an extreme desire to immortalize his name, and would have sacrificed his life to that glory, though he should have been torn to pieces by the mob." (Art. *Spinoza.*)

Note (S. p. 79.)

In proof of the impossibility of Liberty, Collins argues thus:

"A second reason to prove man a necessary agent is, because all his actions have a beginning. For whatever has a beginning must have a cause; and every cause is a necessary cause.

"If anything can have a beginning, which has no cause, then nothing can produce something. And if nothing can produce something, then the world might have had a beginning without a cause; which is an absurdity not only charged on atheists, but is a real absurdity in itself. * * * * * Liberty, therefore, or a power to act or not to act, to do this or another thing under the same causes, is an *impossibility and Atheistical.*"[1]

"And as Liberty stands, and can only be grounded on the absurd principles of Epicurean atheism; so the Epicurean atheists, who were the most popular and most numerous sect of the atheists of antiquity, were the great assertors of liberty; as, on the other side, the Stoics, who were the most popular and numerous sect among the religionaries of antiquity, were the great assertors of *fate* and *necessity.*" (*Collins, p. 54.*)

As to the above *reasoning* of Collins, it cannot be expected that I should, in the compass of a Note, "boult this matter to the bran." It is sufficient here to remark, that it derives all its plausibility from the unqualified terms in which the maxim (μηδὲν ἀναιτίως) has frequently been stated. "In the idea of every *change* (says Dr Price, a zealous advocate for the freedom of the will) is included that of its being an *effect.*" (*Review, &c.* p. 30, 3d Edition.) If this maxim be literally admitted without any explanation or restriction, it seems difficult to resist the conclusions of the Necessitarians. The proper statement of Price's maxim evidently is, that "in every *change* we perceive in *inanimate* matter, the idea of its being an *effect* is necessarily involved;" and that he himself understood it under this limitation appears clearly from the application he makes of it to the point in dispute. As to intelligent and active beings, to affirm that they possess the power of self-determination, seems to me to be little more than an identical proposition. Upon an accurate analysis of the meaning of words, it will be found that the idea of an *efficient* cause implies the idea of *Mind;* and, consequently, that it is absurd to ascribe the volitions of *mind* to the efficiency of causes foreign to itself. To do so must unavoidably involve us in the inconsistencies of Spinozism; by forcing us to conclude that everything is passive, and nothing active in the universe; and, consequently, that the idea of a *First* Cause involves an impossibility.—But upon these hints I must not enlarge at present; and shall, therefore, confine myself to what falls more immediately within the scope of this Discourse, Collins's Historical Statement with respect to the tenets of the Epicureans and the Stoics.

[1] To the same purpose Edwards attempts to show, that "the scheme of free-will (by affording an exception to that dictate of common sense which refers every event to a cause) would destroy the proof *a posteriori* for the being of God."

In confirmation of his assertion concerning the former, he refers to the following well known lines of Lucretius:

Denique si semper motus connectitur omnis.
&c. &c. (*Lucret*, Lib. 2. v. 251.)

On the obscurity of this passage, and the inconsistencies involved in it, much might be said; but it is of more importance, on the present occasion, to remark its complete repugnance to the whole strain and spirit of the Epicurean Philosophy. This repugnance did not escape the notice of Cicero, who justly considers Epicurus as having contributed more to establish, by this puerile subterfuge, the authority of Fatalism, than if he had left the argument altogether untouched. "Nec vero quisquam magis confirmare mihi videtur non modo fatum, verum etiam necessitatem et vim omnium rerum, sustulisseque motus animi voluntarios, quam hic qui aliter obsistere fato fatetur se non potuisse nisi ad has commenticias declinationes confugisset." (*Liber de Fato*, cap. 20.)

On the noted expression of Lucretius (*fatis avolsa voluntas*) some acute remarks are made in a note on the French translation by M. de la Grange. They are not improbably from the pen of the Baron d'Holbach, who is said to have contributed many notes to this translation. Whoever the author was, he was evidently strongly struck with the inconsistency of this particular tenet with the general principles of the Epicurean System.

"On est surpris qu' Epicure fonde la liberté humaine sur la déclinaison des atomes. On demande si cette declinaison est nécessaire, ou si elle est simplement accidentelle. Nécessaire, comment la liberté peut elle en être le resultat? Accidentelle, par quoi est elle déterminée? Mais on devrait bien plutot être surpris, qu'il lui soit venu en idée de rendre l'homme libre dans un systéme qui suppose un enchainement nécessaire de causes et d'effets. C'etoit une recherche curieuse, que la raison qui a pu faire d'Epicure l'Apôtre de la Liberté." For the theory which follows on this point, I must refer to the work in question. (See *Traduction Nouvelle de Lucrece, avec des Notes*, par M. de la Grange, Vol. I. pp. 218, 219, 220, à Paris, 1768.)

But whatever may have been the doctrines of some of the *ancient* Atheists about man's free-agency, it will not be denied, that in the *History of* MODERN *Philosophy*, the schemes of Atheism and of Necessity have been hitherto always connected together. Not that I would by any means be understood to say, that every Necessitarian must *ipso facto* be an Atheist, or even, that any presumption is afforded by a man's attachment to the former sect, of his having the slightest bias in favour of the latter; but only that every modern Atheist I have heard of has been a Necessitarian. I cannot help adding, that the most consistent Necessitarians who have yet appeared, have been those who followed out their principles till they ended in *Spinozism*, a doctrine which differs from atheism more in words than in reality.

In what Collins says of the Stoics in the above quotation, he plainly proceeds on the supposition that all Fatalists are of course Necessitarians;[1] and I agree with him in thinking, that this would be the case, if they reasoned logically. It is certain, however, that a great proportion of those who have belonged to the first sect have disclaimed all connection with the second. The Stoics themselves furnish one very remarkable instance. I do not know any author by whom the liberty of the will is stated in stronger and more explicit terms, than it is by Epictetus in the very first sentence of the Enchiridion. Indeed the Stoics seem, with their usual passion for exaggeration, to have carried their ideas about the freedom of the will to an unphilosophical extreme.

[1] Collins states this more strongly in what he says of the Pharisees. "The Pharisees, who were a religious sect, ascribed all things to fate or to God's appointment, and it was the first article of their creed, that Fate and God do all, and, consequently, they could not assert a *true* liberty when they asserted a liberty together with this fatality and *necessity* of all things." (Collins, p. 54.)

If the belief of man's free-agency has thus maintained its ground among professed Fatalists, it need not appear surprising, that it should have withstood the strong arguments against it, which the doctrine of the eternal decrees of God, and even that of the Divine prescience, appear at first sight to furnish. A remarkable instance of this occurs in St Augustine (distinguished in ecclesiastical history by the title of *the Doctor of Grace*), who has asserted the liberty of the will in terms as explicit as those in which he has announced the theological dogmas with which it is most difficult to reconcile it. Nay, he has gone so far as to acknowledge the essential importance of this belief, as a motive to virtuous conduct. "Quocirca nullo modo cogimur, aut retentâ præscientiâ Dei, tollere voluntatis arbitrium, aut retento voluntatis arbitrio, Deum, quod nefas est, negare præscium futurorum, sed utrumque amplectimur, utrumque fidelitur et veraciter confitemur: illud, ut bene credamus; *hoc ut bene vivamus*."

Descartes has expressed himself on this point nearly to the same purpose with St Augustine. In one passage he asserts, in the most unqualified terms, that God is the cause of all the actions which depend on the Free-will of Man; and yet, that the Will is really free, he considers as a fact perfectly established by the evidence of consciousness. "Sed quemadmodum existentiæ divinæ cognitio non debet liberi nostri arbitrii certitudinem tollere, quia illud in nobismet ipsis experimur et sentimus; ita neque liberi nostri arbitrii cognitio existentiam Dei apud nos dubiam facere debet. Independentia enim illa quam experimur, atque in nobis persentiscimus, et quæ actionibus nostris laude vel vituperio dignis efficiendis sufficit, non pugnat cum dependentia alterius generis, secundum quam omnia Deo subjiciuntur." (Cartesii *Epistolæ*, Epist. VIII. IX. Pars i.) These letters form part of his correspondence with the Princess Elizabeth, daughter of Frederick, King of Bohemia, and Elector Palatine.

We are told by Dr Priestley, in the very interesting *Memoirs of his own Life*, that he was educated in the strict principles of Calvinism; and yet it would appear, that while he remained a Calvinist, he entertained no doubt of his being a free-agent. "The doctrine of necessity (he also tells us) he *first* learned from Collins;[1] and was established in the belief of it by Hartley's *Observations on Man*." (*Ibid.* p. 19.) He farther mentions in another work, that "he was not a ready convert to the doctrine of necessity, and that, like Dr Hartley himself, he gave up his liberty with great reluctance." (*Preface to the Doctrine of Philosophical Necessity Illustrated*, 2d Edit. Birmingham, 1782, p. xxvii.)

These instances afford a proof, I do not say of the compatibility of man's free-agency with those schemes with which it seems most at variance, but of this compatibility in the opinion of some of the profoundest thinkers who have turned their attention to the argument. No conclusion, therefore, can be drawn against a man's belief in his own free-agency, from his embracing other metaphysical or theological tenets, with which it may appear to ourselves impossible to reconcile it.

As for the notion of liberty, for which Collins professes himself an advocate, it is precisely that of his predecessor Hobbes, who defines a free-agent to be, "he that can do if he will, and forbear if he will." (Hobbes's *Works*, p. 484, fol. ed.) The same definition has been adopted by Leibnitz, by Gravesande, by Edwards, by Bonnet, and by all our later necessitarians. It cannot be better ex-

[1] We are elsewhere informed by Priestley, that "it was in consequence of reading and studying the *Inquiry* of Collins, he was first convinced of the truth of the doctrine of Necessity, and was enabled to see the fallacy of most of the arguments in favour of Philosophical Liberty: though (he adds) I was much more confirmed in this principle by my acquaintance with *Hartley's Theory of the Human Mind*; a work to which I owe much more than I am able to express."—(*Preface, &c. &c.* p. xxvii.)

pressed than in the words of Gravesande: "*Facultas faciendi quod libuerit, quæcunque fuerit voluntatis determinatio.*" (*Introd. ad Philosoph.* § 115.)

Dr Priestley ascribes this peculiar notion of free-will to Hobbes as its author;[1] but it is, in fact, of much older date even among modern metaphysicians; coinciding exactly with the doctrine of those scholastic divines who contended for the *Liberty of Spontaneity*, in opposition to the *Liberty of Indifference*. It is, however, to Hobbes that the partizans of this opinion are indebted for the happiest and most popular illustration of it that has yet been given. "I conceive (says he) liberty to be rightly defined, The absence of all the impediments to action that are not contained in the nature and intrinsical quality of the agent. As, for example, the water is said to descend *freely*, or to have liberty to descend by the channel of the river, because there is no impediment that way: but *not* across, because the banks are impediments. And though water cannot ascend, yet men never say, it wants the *liberty* to ascend, but the *faculty* or power, because the impediment is in the nature of the water, and intrinsical. So also we say, he that is tied wants the *liberty* to go, because the impediment is not in him, but in his hands; whereas we say not so of him who is sick or lame, because the impediment is in himself." (*Treatise of Liberty and Necessity.*)

According to Bonnet, "moral liberty is the power of the mind to obey without constraint the impulse of the motives which act upon it." This definition, which is obviously the same in substance with that of Hobbes, is thus very justly, as well as acutely, animadverted on by Cuvier. "N'admettant aucune action sans motif, comme dit-il, il n'y a aucun effet sans cause, Bonnet definit la *liberté morale* le pouvoir de l'âme de suivre sans contrainte les motifs dont elle éprouve l'impulsion; et résout ainsi les objections que l'on tire de la prévision de Dieu; mais peut-être aussi detournent-t-il l'idée qu'on se fait d'ordinaire de la liberté. Malgré ces opinions que touchent au Matérialisme et au Fatalisme, Bonnet fut très religieux." (*Biographie Universelle*, à Paris, 1812. Art. Bonnet.)

From this passage, it appears, that the very ingenious writer was as completely aware as Clarke or Reid, of the unsoundness of the definition of *moral liberty* given by Hobbes and his followers; and that the ultimate tendency of the doctrine which limits the free-agency of man to (what has been called) the *liberty of spontaneity*, was the same, though in a more disguised form, with that of fatalism.

For a complete exposure of the futility of this definition of *liberty*, as the word is employed in the controversy about man's free-agency, I have only to refer to Clarke's remarks on Collins, and to Dr Reid's *Essays on the Active Powers of Man.* In this last work, the various meanings of this very ambiguous word are explained with great accuracy and clearness.

The only two opinions which, in the actual state of metaphysical science, ought to be stated in contrast, are that of Liberty (or free-will) on the one side, and that of Necessity on the other. As to the *Liberty of Spontaneity* (which expresses a fact altogether foreign to the point in question), I can conceive no motive for inventing such a phrase, but a desire in some writers to veil the scheme of necessity from their readers, under a language less revolting to the sentiments of mankind: and, in others, an anxiety to banish it as far as possible from their own thoughts, by substituting, instead of the terms in which it is commonly expressed, a circumlocution which seems, on a superficial view, to concede something to the advocates for liberty.

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[1] "The doctrine of philosophical necessity," says Priestley, "is in reality a modern thing, not older, I believe, than Mr Hobbes. Of the Calvinists, I believe Mr Jonathan Edwards to be the first." (*Illustrations of Philosophical Necessity*, p. 195.)

Supposing this statement to be correct, does not the very modern date of Hobbes's alleged *discovery* furnish a very strong presumption against it?

If this phrase (the *Liberty of Spontaneity*) should fall into disuse, the other phrase (the *Liberty of Indifference*),[1] which is commonly stated in opposition to it, would become completely useless; nor would there be occasion for qualifying with any epithet, the older, simpler, and much more intelligible word *Free-will.*

The distinction between *physical* and *moral* necessity I conceive to be not less frivolous than those to which the foregoing animadversions relate. On this point I agree with Diderot, that the word *necessity* (as it ought to be understood in this dispute) admits but of *one* interpretation.

Note (T.) p. 79.

To the arguments of Collins, against man's free-agency, some of his successors have added, the inconsistency of this doctrine with the known *effects of education* (under which phrase they comprehend the moral effects of all the external circumstances in which men are involuntarily placed) in forming the characters of individuals.

The plausibility of this argument (on which much stress has been laid by Priestley and others) arises entirely from the mixture of truth which it involves; or, to express myself more correctly, from the evidence and importance of *the fact* on which it proceeds, when that fact is stated with due limitations.

That the influence of *education*, in this comprehensive sense of the word, was greatly underrated by our ancestors, is now universally acknowledged; and it is to Locke's writings, more than to any other single cause, that the change in public opinion on this head is to be ascribed. On various occasions, he has expressed himself very strongly with respect to the *extent* of this influence; and has more than once intimated his belief, that the great majority of men continue through life what early education had made them. In making use, however, of this strong language, his object (as is evident from the opinions which he has avowed in other parts of his works) was only to arrest the attention of his readers to the practical lessons he was anxious to inculcate; and not to state a metaphysical fact which was to be literally and rigorously interpreted in the controversy about liberty and necessity. The only sound and useful *moral* to be drawn from the *spirit* of his observations is, the duty of gratitude to Heaven for all the blessings, in respect of education and of external situation, which have fallen to our own lot; the impossibility of ascertaining the involuntary misfortunes by which the seeming demerits of others may have been in part occasioned, and in the same proportion diminished; and the consequent obligation upon ourselves, to think as charitably as possible of their conduct, under the most unfavourable appearances. The truth of all this I conceive to be implied in these words of Scripture, "To whom much is given, of him much will be required;" and, if possible, still more explicitly and impressively, in the Parable of the Talents.

Is not the use which has been made by Necessitarians of Locke's *Treatise on Education*, and other books of a similar tendency, only one instance more of that disposition, so common among metaphysical Sciolists, to appropriate to themselves the conclusions of their wiser and more sober predecessors, under the startling and imposing disguise of universal maxims, admitting neither of exception nor restriction? It is thus that Locke's judicious and refined remarks on the *Association of Ideas* have been exaggerated to such an extreme in the coarse *caricatures* of Hartley and of Priest-

[1] Both phrases are favourite expressions with Lord Kames in his discussions on this subject. See in particular the Appendix to his *Essay on Liberty and Necessity*, in the last Edition of his *Essays on Morality and Natural Religion.*

ley, as to bring, among cautious inquirers, some degree of discredit on one of the most important doctrines of modern philosophy. Or, to take another case still more in point; it is thus that Locke's reflections on the effects of education in modifying the intellectual faculties, and (where skilfully conducted) in supplying their original defects, have been distorted into the puerile paradox of Helvetius, that the mental capacities of the whole human race are the same at the moment of birth. It is sufficient for me here to throw out these hints, which will be found to apply equally to a large proportion of other theories started by modern metaphysicians.

Before I finish this note, I cannot refrain from remarking, with respect to the argument for Necessity drawn from the Divine prescience, that, if it be conclusive, it only affords an additional confirmation of what Clarke has said concerning the identity of the creed of the Necessitarians with that of the Spinozists. For, if God certainly foresees all the future volitions of his creatures, he must, for the same reason, foresee all *his own* future volitions; and if this knowledge infers *a necessity* of volition in the one case, how is it possible to avoid the same inference in the other?

NOTE (U.) p. 80.

A SIMILAR application of St Paul's comparison of the *potter* is to be found both in Hobbes and in Collins. Also, in a note annexed by Cowley to his ode entitled *Destiny;* an ode written (as we are informed by the author) "upon an extravagant supposition of two angels playing a game at chess; which, if they did, the spectators would have reason as much to believe that the pieces moved themselves, as we have for thinking the same of mankind, when we see them exercise so many and so different actions. It was of old said by Plautus, *Dii nos quasi pilas homines habent.* "We are but tennis-balls for the gods to play withal," which they strike away at last, and still call for new ones; and St Paul says, "*We are but the clay in the hand of the potter.*"

For the comparison of *the potter*, alluded to by these different writers, see the epistle to the Romans, Chap. ix. verses 18, 19, 20, 21. Upon these verses the only comment which I have to offer is a remark of the Apostle Peter; that "In the epistles of our beloved brother Paul are some things hard to be understood, which they that are unlearned and unstable wrest unto their own destruction."

The same similitude of *the potter* makes a conspicuous figure in the writings of Hobbes, who has availed himself of this, as of many other insulated passages of Holy Writ, in support of principles which are now universally allowed to strike at the very root of religion and morality. The veneration of Cowley for Hobbes is well known, and is recorded by himself in the ode which immediately precedes that on Destiny. It cannot, however, be candidly supposed, that Cowley understood the whole drift of Hobbes' doctrines. The contrary, indeed, in the present instance, is obvious from the ode before us; for while Cowley supposed the angels to move, like chess-men, the inhabitants of this globe, Hobbes (along with Spinoza) plainly conceived that the angels themselves, and even that Being to which he impiously gave the name of *God*, were all of them moved, like knights and pawns, by the invisible hand of fate or necessity.

Were it not for the serious and pensive cast of Cowley's mind, and his solemn appeal to the authority of the apostle, in support of the doctrine of *destiny*, one would be tempted to consider the first stanzas of this ode in the light of a *jeu d'esprit*, introductory to the very characteristical and interesting picture of himself, with which the poem concludes.

NOTE (X.) p. 82.

"TOUT ce qui est doit être, par cela même que cela est. Voilà la seule bonne philosophie. Aussi longtemps que nous ne connaîtrons pas cet univers, comme on dit dans l'école, *a priori*, tout est nécessité. La liberté est un mot vide de sens, comme vous allez voir dans la lettre de M. Diderot." (Lettre de Grimm au Duc de Saxe-Gotha.)

"C'est ici mon cher, que je vais quitter le ton de prédicateur pour prendre, si je peux, celui de philosophe. Regardez-y de près, et vous verrez que le mot liberté est un mot vide de sens; qu'il n'y a point, et qu'il ne peut y avoir d'êtres libres; que nous ne sommes que ce qui convient à l'ordre général, à l'organisation, à l'éducation, et à la chaîne des événemens. Voilà ce qui dispose de nous invinciblement. On ne conçoit non plus qu'un être agisse sans motif, qu'un des bras d'une balance agisse sans l'action d'un poids, et le motif nous est toujours extérieur, étranger, attachés ou par une nature ou par une cause quelconque, qui n'est pas nous. Ce qui nous trompe, c'est la prodigieuse variété de nos actions, jointe à l'habitude que nous avons prise tout en naissant, de confondre le volontaire avec le libre. Nous avons tant loué, tant repris, nous l'avons été tant de fois, que c'est un préjugé, bien vieux que celui de croire que nous et les autres voulons, agissons librement. Mais s'il n'y a point de liberté, il n'y a point d'action qui merite la louange ou le blâme; il n'y a ni vice, ni vertu, rien dont il faille récompenser ou châtier. Qu'est ce qui distingue donc les hommes? La bienfaisance ou la malfaisance. Le malfaisant est un homme qu'il faut détruire, en non punir; la bienfaisance est une bonne fortune, et non une vertu. Mais quoique l'homme bien ou malfaisant ne soit pas libre, l'homme n'en est pas moins un être qu'on modifie; c'est par cette raison qu'il faut détruire le malfaisant sur une place publique. De là les bons effets de l'exemple, des discours, de l'éducation, du plaisir, de la douleur, des grandeurs, de la misère, &c.; de là une sorte de philosophie pleine de commisération, qui attache fortement aux bons, qui n'irrite non plus contre le méchant, que contre un ouragan qui nous remplit les yeux de poussière. Il n'y a qu'une sorte de causes à proprement parler; ce sont les causes physiques. Il n'y a qu'une sorte de nécessité, c'est la même pour tous les êtres. Voilà ce qui me réconcilie avec le genre humain; c'est pour cette raison que je vous exhortais à la philanthropie. Adoptez ces principes si vous les trouvez bons, ou montrez-moi qu'ils sont mauvais. Si vous les adoptez, ils vous réconcilieront aussi avec les autres et avec vous-même; vous ne vous saurez ni bon ni mauvais gré d'être ce qui vous êtes. Ne rien reprocher aux autres, ne se repentir de rien; voilà les premiers pas vers la sagesse. Ce qui est hors de là est préjugé, fausse philosophie." (*Correspondance Littéraire, Philosophique, et Critique, addressée au Duc de Saxe-Gotha*, par le Baron de Grimm et par Diderot. Première Partie, Tom. I. pp. 300, 304, 305, 306, Londres, 1814.)

NOTE (Y.) p. 91.

SEE in Bayle the three articles *Luther*, *Knox*, and *Buchanan*. The following passage concerning Knox may serve as a specimen of the others. It is quoted by Bayle from the *Cosmographie Universelle* of Thevet, a writer who has long sunk into the contempt he merited, but whose zeal for legitimacy and the Catholic faith raised him to the dignity of almoner to Catherine de Medicis, and of historiographer to the King of France. I borrow the translation from the English *Historical Dictionary*.

"During that time the Scots never left England in peace; it was when Henry VIII. played his

pranks with the chalices, relics, and other ornaments of the English churches; which tragedies and plays have been acted in our time in the kingdom of Scotland, by the exhortations of Noptz,[1] the first Scots minister of the bloody Gospel. This firebrand of sedition could not be content with barely following the steps of Luther, or of his master, Calvin, who had not long before delivered him from the gallies of the Prior of Capua, where he had been three years for his crimes, unlawful amours, and abominable fornications; for he used to lead a dissolute life, in shameful and odious places, and had been also found guilty of the parricide and murder committed on the body of the Archbishop of St Andrew's, by the contrivances of the Earl of Rophol, of James Lescle, John Lescle, their uncle, and William du Coy. This simonist, who had been a priest of our church, being fattened by the benefices he had enjoyed, sold them for ready money; and finding that he could not make his cause good, he gave himself up to the most terrible blasphemies. He persuaded also several devout wives and religious virgins to abandon themselves to wicked adulterers. Nor was this all. During two whole years, he never ceased to rouse the people, encouraging them to take up arms against the Queen, and to drive her out of the kingdom, which he said was elective, as it had been formerly in the time of heathenism. . . . . The Lutherans have churches and oratories. Their ministers sing psalms, and say mass; and though it be different from ours, yet they add to it the Creed, and other prayers, as we do. And when their ministers officiate, they wear the cope, the chasuble, and the surplice, as ours do, being concerned for their salvation, and careful of what relates to the public worship. Whereas the Scots have lived these twelve years past without laws, without religion, without ceremonies, constantly refusing to own a King or a Queen, as so many brutes, suffering themselves to be imposed upon by the stories told them by this arch-hypocrite Noptz, a traitor to God and to his country, rather than to follow the pure Gospel, the councils, and the doctrine of so many holy doctors, both Greek and Latin, of the Catholic church."

If any of my readers be yet unacquainted with the real character and history of this distinguished person, it may amuse them to compare the above passage with the very able, authentic, and animated account of his life, lately published by the reverend and learned Dr M'Crie.

Note (Z.) p. 100.

Dr Blair (whose estimate of the distinguishing beauties and imperfections of Addison's style reflects honour on the justness and discernment of his taste) has allowed himself to be carried along much too easily, by the vulgar sneers at Addison's want of philosophical depth. In one of his lectures on rhetoric he has even gone so far as to accuse Addison of misapprehending, or, at least, of *mis-stating* Locke's doctrine concerning *secondary qualities*. But a comparison of Dr Blair's own statement with that which he censures, will not turn out to the advantage of the learned critic; and I willingly lay hold of this example, as the point at issue turns on one of the most refined questions of metaphysics. The words of Addison are these:—

"Things would make but a poor appearance to the eye, if we saw them only in their proper figures and motions. And what reason can we assign for their exciting in us many of those ideas which are different from any thing that exists in the objects themselves (for such are *light and* colours), were it not to add supernumerary ornaments to the universe, and make it more agreeable to the imagination?"

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[1] Thus Thevet (says Bayle) writes the name of Knox.

After quoting this sentence, Dr Blair proceeds thus:—

"Our author is now entering on a theory, which he is about to illustrate, if not with much philosophical accuracy, yet with great beauty of fancy and glow of expression. A strong instance of his want of accuracy appears in the manner in which he opens the subject. For what meaning is there in things *exciting in us many of those ideas which are different from any thing that exists in the objects?* No one, sure, ever imagined that our ideas exist in the objects. Ideas, it is agreed on all hands, can exist no where but in the mind. What Mr Locke's philosophy teaches, and what our author should have said, is, *exciting in us many ideas of qualities which are different from any thing that exists in the objects.*"

Let us now attend to Locke's theory as stated by himself:—

"From whence I think it is easy to draw this observation, That the *ideas* of primary qualities of bodies are *resemblances* of them, *and their patterns do really exist in the bodies themselves*, but the *ideas* produced in us by these secondary qualities have *no resemblance* of them at all. There is nothing *like* our ideas existing in the bodies themselves. They are in the bodies we denominate from them, only a power to produce these sensations in us. And what is sweet, blue, or warm in *idea*, is but the certain bulk, figure, and motion of the insensible parts in the bodies themselves, which we call so."

The inaccuracy of Locke in conceiving that our *ideas* of primary qualities are *resemblances* of these qualities, and that the *patterns* of such ideas exist in the bodies themselves, has been fully exposed by Dr Reid. But the *repetition* of Locke's inaccuracy (supposing Addison to have been really guilty of it) should not be charged upon him as a *deviation* from his master's doctrine. To all, however, who understand the subject, it must appear evident, that Addison has, in this instance, *improved* greatly on Locke, by keeping out of view what is most exceptionable in his language, while he has retained all that is solid in his doctrine. For my own part, I do not see how Addison's expressions could be altered to the better, except, perhaps, by substituting the words *unlike to*, instead of *different form*. But in this last phrase, Addison has been implicitly followed by Dr Blair, and certainly would not have been disavowed as an interpreter by Locke himself. Let me add, that Dr Blair's proposed emendation ("exciting in us many ideas *of qualities*, which are different from any thing that exists in the objects"), if not wholly unintelligible, deviates much farther from Locke's meaning than the correspondent clause in its original state. The additional words *of qualities* throw an obscurity over the whole proposition, which was before sufficiently precise and perspicuous.[1]

My principal reason for offering these remarks in vindication of Addison's account of secondary qualities was, to prepare the way for the sequel of the passage animadverted on by Dr Blair.

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[1] Another passage, afterwards quoted by Dr Blair, might have satisfied him of the clearness and accuracy of Addison's ideas on the subject.

"I have here supposed that my reader is acquainted with that great modern discovery, which is, at present, universally acknowledged by all the inquirers into natural philosophy; namely, that light and colours, *as apprehended by the imagination*, are only ideas in the mind, and not qualities that have any existence in matter. As this is a truth which has been proved incontestibly by many modern philosophers, if the English reader would see the notion explained at large, he may find it in the eighth book of Mr Locke's *Essay on Human Understanding*."

I have already taken notice (*Elements of the Philosophy of the Human Mind*, Vol. I. Note P.) of the extraordinary precision of the above statement, arising from the clause printed in Italics. By a strange slip of memory I ascribed the merit of this very judicious qualification, not to Addison, but to Dr Akenside, who transcribed it from the Spectator.

The last quotation affords me also an opportunity of remarking the correctness of Addison's information about the history of this doctrine, which most English writers have conceived to be an original speculation of Locke's. From some of Addison's expressions, it is more than probable, that he had derived his first knowledge of it from Malebranche.

"We are everywhere entertained with pleasing shows and apparitions. We discover imaginary glories in the heavens and in the earth, and see some of this visionary beauty poured out upon the whole creation. But what a rough unsightly sketch of nature should we be entertained with, did all her colouring disappear, and the several distinctions of light and shade vanish?[1] In short, our souls are delightfully lost and bewildered in a pleasing delusion, and we walk about like the enchanted hero of a romance, who sees beautiful castles, woods, and meadows, and, at the same time, hears the warbling of birds and the purling of streams: but, upon the finishing of some secret spell, the fantastic scene breaks up, and the disconsolate knight finds himself on a barren heath, or in a solitary desert."

In this passage one is at a loss whether most to admire the author's depth and refinement of thought, or the singular felicity of fancy displayed in its illustration. The image of the *enchanted hero* is so unexpected, and, at the same time, so exquisitely appropriate, that it seems itself to have been conjured up by an enchanter's wand. Though introduced with the unpretending simplicity of a poetical simile, it has the effect of shedding the light of day on one of the darkest corners of metaphysics. Nor is the language in which it is conveyed unworthy of the attention of the critic; abounding throughout with those natural and happy graces, which appear artless and easy to all but to those who have attempted to copy them.

The praise which I have bestowed on Addison as a commentator on this part of Locke's Essay will not appear extravagant to those who may take the trouble to compare the conciseness and elegance of the foregoing extracts with the prolixity and homeliness of the author's text. (See Locke's *Essay*, Book II. chap. viii. §§ 17, 18.) *It is sufficient to mention here, that* his chief illustration is taken from "the effects of manna on the stomach and guts."

NOTE (AA.) p. 111.

For the following note I am indebted to my learned friend Sir William Hamilton, Professor of Universal History in the University of Edinburgh.

"The *Clavis Universalis* of Arthur Collier, though little known in England, has been translated into German. It is published in a work entitled "*Samlung*, &c. &c. literally, "A Collection of the most distinguished authors who deny the existence of their own bodies, and of the whole material world,—containing the dialogues of Berkeley, between Hylas and Philonous, and Collier's *Universal Key* translated, with Illustrative Observations, and an Appendix, wherein the existence of Body is demonstrated, by John Christopher Eschenbach, Professor of Philosophy in Rostock." (Rostock, 1756, 8vo.) The remarks are numerous, and show much reading. The Appendix contains, 1. An exposition of the opinion of the Idealists, with its grounds and arguments. 2. A proof of the external existence of body. The argument on which he chiefly dwells to show the existence of matter is the same with that of Dr Reid, in so far as he says "a direct proof must not here be expected; in regard to the fundamental principles of human nature, this is seldom possible, or rather is absolutely impossible." He argues at length, that the Idealist has no better proof of the existence of his soul than of the existence of his body; "when an Idealist says, *I am a thinking being*; *of this I am certain from internal conviction*;—I would ask from whence he derives this certainty, and why he ex-

[1] On the supposition made in this sentence, the face of Nature, instead of presenting a "rough unsightly sketch," would, it is evident, become wholly invisible. But I need scarcely say, this does not render Mr Addison's allusion less pertinent.

cludes from this conviction the possibility of deception? He has no other answer than this, *I feel it. It is impossible that I can have any representation of self without the consciousness of being a thinking being.* In the same manner, Eschenbach argues that the *feeling* applies to the existence of body, and that the ground of belief is equally strong and conclusive, in respect to the reality of the *objective*, as of the *subjective*, in perception."

Note (BB.) p. 132.

" *And yet Diderot, in some of his lucid intervals, seems to have thought and felt very differently.*"

The following passage (extracted from his *Pensées Philosophiques*) is pronounced by La Harpe to be not only one of the most eloquent which Diderot has written, but to be one of the best comments which is any where to be found on the Cartesian argument for the existence of God. It has certainly great merit in point of reasoning, but I cannot see with what propriety it can be considered as a comment upon the argument of Descartes; nor am I sure if, in point of eloquence, it be as well suited to the English as to the French taste.

" Convenez qu'il y auroit de la folie à refuser à vos semblables la faculté de penser. Sans doute, mais que s'ensuit-il de là? Il s'ensuit, que si lunivers, que dis-je l'univers, si l'aile d'un papillon m'offre des traces mille fois plus distinctes d'une intelligence que vous n'avez d'indices que votre semblable à la faculté de penser, il est mille fois plus fou de nier qu'il existe un Dieu, que de nier que votre semblable pense. Or, que cela soit ainsi, c'est à vos lumières, c'est à votre conscience que j'en appelle. Avez-vous jamais remarqué dans les raisonnemens, les actions, et la conduite de quelque homme que ce soit, plus d'intelligence, d'ordre, de sagacité, de conséquence, que dans le mécanisme d'un insècte? La divinité n'est elle pas aussi clarement empreinte dans l'œil d'un ciron, que la faculté de penser dans les ecrits du grand Newton? Quoi! le monde formé prouverait moins d'intelligence, que le monde expliqué? Quelle assertion! l'intelligence d'un premier être ne m'est pas mieux demontrée par ses ouvrages, que la faculté de penser dans un philosophe par ses ecrits? Songez donc que je ne vous objecte que l'aile d'un papillon, quand je pourrais vous écraser du poids de l'univers."

This, however, was certainly not the creed which Diderot professed in his more advanced years. The article, on the contrary, which immediately follows the foregoing quotation, there is every reason to think, expresses his real sentiments on the subject. I transcribe it at length, as it states clearly and explicitly the same argument which is indirectly hinted at in a late publication by a far more illustrious author.

" J'ouvre les cahiers d'un philosophe célèbre, et je lis. Athées, je vous accorde que le mouvement est essentiel à la matière; qu'en concluez-vous? que le monde resulte du jet fortuit d'atomes? J'aimerois autant que vouz me dissiez que l'Iliade d'Homère ou la Henriade de Voltaire est un resultat de jets fortuits de caractères?' Je me garderai bien de faire ce raisonnement à un athée. Cette comparaison lui donneroit beau jeu. Selon les lois de l'analyse des sorts, me diroit-il, je ne doit être surpris qu'une chose arrive, lorsqu'elle est possible, et que la difficulté de l'événement est compensée par la quantité des jets. Il y a tels nombre de coups dans lesquels je gagerois avec avantage d'amener cent mille six à la fois avec cent mille dez. Quelle que fût la somme finie de caractères avec laquelle on me proposeroit d'engendrer fortuitement l'Iliade, il y a telle somme finie de jets qui me rendroit la proposition avantageuse; mon avantage seroit même infinie, si la quantité de jets accordée etoit infini," &c. &c. (*Pensées Philosophiques*, par Diderot, XXI.)

My chief reason for considering this as the genuine exposition of Diderot's own creed is, that he omits no opportunity of suggesting the same train of thinking in his other works. It may be distinctly traced in the following passage of his *Traité du Beau*, the substance of which he has also introduced in the article BEAU of the *Encyclopédie.*

"Le beau n'est pas toujours l'ouvrage d'une cause intelligente; le mouvement etablit souvent, soit dans un être consideré solitairement, soit entre plusieurs êtres comparés entr'eux, une multitude prodigieuse de rapports surprenans. Les cabinets d'historie naturelle en offrent un grand nombre d'exemples. Les rapports sont alors des resultats de combinaisons fortuites, du moins par rapport à nous. La nature imite en se jouant, dans cent occasions, les productions d'art; et l'on pourroit demander, je ne dis pas si ce philosophe qui fut jeté par une tempête sur les bords d'une Ile inconnue, avoit raison de se crier, à la vue de quelques figures de geometrie; '*Courage mes amis, voici des pas d'hommes;*' mais combien il faudroit remarquer de rapports dans un être, pour avoir une certitude complète qu'il est l'ouvrage d'un artiste[1] (en quelle occasion, un seul defaut de symmetrie prouveroit plus que toute somme donnée de rapports); comment sont entr'eux le temps de l'action de la cause fortuite, et les rapports observés dans les effets produits; et si (à l'exception des œuvres du Tout-Puissant)[2] il y a des cas ou le nombre des rapports ne puisse jamais être compensé par celui des jets."

With respect to the passages here extracted from Diderot, it is worthy of observation, that if the atheistical argument from chances be conclusive in its application to that order of things which we behold, it is not less conclusive when applied to every other possible combination of atoms which imagination can conceive, and affords a mathematical proof, that the fables of Grecian mythology, the tales of the genii, and the dreams of the Rosicrusians, *may*, or rather *must*, all of them, be somewhere or other realised in the infinite extent of the universe; a proposition which, if true, would destroy every argument for or against any given system of opinions founded on the reasonableness or the unreasonableness of the tenets involved in it; and would, of consequence, lead to the subversion of the whole frame of the human understanding.[3]

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[1] Is not this precisely the sophistical mode of questioning known among Logicians by the name of *Sorites* or *Acervus*? 'Vitiosum sane (says Cicero) et captiosum genus.' (*Acad. Quæst.* Lib. IV. xvi.)

[2] To those who enter fully into the spirit of the foregoing reasoning, it is unnecessary to observe, that this parenthetical clause is nothing better than an ironical *salvo*. If the argument proves any thing it leads to this general conclusion, that the apparent order of the universe affords no evidence whatever of the existence of a designing cause.

[3] The atheistical argument here quoted from Diderot is, at least, as old as the time of Epicurus.

Nam certè neque consilio primordia rerum
Ordine se quæque, atque sagaci mente locârunt;
Nec quos quæque darent motus pepigere profectò;
Sed quia multimodis, multis, mutata, per omne
Ex infinito vexantur percita plagis,
Omne genus motûs, et cœtûs experiundo,
Tandem deveniunt in taleis dispositluras,
Qualibus hæc rebus consistit summa creata.
(Lucret. Lib. I. l. 1020.)

And still more explicitly in the following lines:

Nam cùm respicias immensi temporis omne
Præteritum spatium; tum motus materiai
Multimodi quàm sint; facilè hoc adcredere possis,
Semina sæpe in eodem, ut nunc sunt, ordine posta.
(Ibid. Lib. III. l. 867.)

Mr Hume, in his *Natural History of Religion*, (Sect. XI.), has drawn an inference from the internal evidence of the Heathen Mythology, in favour of the supposition, that it may not be altogether so fabulous as is commonly supposed. " The whole mythological system is so natural, that in the vast variety of planets and worlds contained in this universe, *it seems more than probable* that somewhere or other it is really carried into execution." The argument of Diderot goes much farther, and leads to an extension of Mr Hume's conclusion to all conceivable systems, whether *natural* or not.

But further, since the human mind, and all the numberless displays of wisdom and of power which it has exhibited, are ultimately to be referred to a fortuitous concourse of atoms, why might not the Supreme Being, such as we are commonly taught to regard him, have been Himself (as well as the Gods of Epicurus)[1] the result of the continued operation of the same blind causes? or rather, *must* not such a Being have necessarily resulted from these causes operating from all eternity, through the immensity of space?—a conclusion, by the way, which, according to Diderot's own principles, would lead us to refer the era of his origin to a period indefinitely more remote than any given point of time which imagination can assign; or, in other words, to a period to which the epithet *eternal* may with perfect propriety be applied. The amount, therefore, of the whole matter is this, that the atheistical reasoning, as stated by Diderot, leaves the subject of natural, and, I may add, of revealed religion, precisely on the same footing as before, without invalidating, in the very smallest degree, the evidence for any one of the doctrines connected with either; nay more, superadding to this evidence, a mathematical demonstration of the *possible* truth of all those articles of belief which it was the object of Diderot to subvert from their foundation.

It might be easily shown, that these principles, if pushed to their legitimate consequences, instead of establishing the just authority of reason in our constitution, would lead to the most unlimited credulity on all subjects whatever; or (what is only another name for the same thing) to that state of mind, which, in the words of Mr Hume, " does not consider any one proposition as more certain, or even as more probable, than another."

The following curious and (in my opinion) instructive anecdote has a sufficient connection with the subject of this note, to justify me in subjoining it to the foregoing observations. I transcribe it from the Notes annexed to the Abbé de Lille's poem, entitled *La Conversation*. (A Paris, 1812.)

" Dans la société du Baron d'Holbach, Diderot proposa un jour de nommer un *avocat de Dieu*, et on choisit l'Abbé Galiani. Il s'assit et débuta ainsi.

" Un jour à Naples, un homme de la Basilicate prit devant nous, six déz dans un cornet, et paria d'amener rafle de six. Je dis cette chance étoit possible. Il l'amena sur le champ une seconde fois; je dis la même chose. Il remit les dés dans le cornet trois, quatre, cinq fois, et toujours rafle de six. *Sangue di Bacco* m'ecriai-je, *les dés sont pipés ;* et ils l'étoient.

" Philosophes, quand je considere l'orde toujours renaissant de la nature, ses lois immuables, ses révolutions toujours constantes dans une variété infinie; cette chance unique et conservatrice d'un univers tel que nous le voyons, qui revient sans cesse, malgré cent autres millions de chances de perturbation et de destruction possibles, je m'ecrie: *certes la nature est pipée !*"

The argument here stated strikes me as irresistible, nor ought it at all to weaken its effect, that it was spoken by the mouth of the Abbé Galiani. Of this extraordinary person I shall have occasion afterwards to speak as a political economist.

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[1] *Cic. de Nat. Deor.* Lib. I. XXIV.

Whatever his own professed principles may have been, this theory of the *loaded die* appears evidently, from the repeated allusions to it in his familiar correspondence, to have produced a very deep impression on his mind. (See *Correspondance inédite de* l'Abbé Galiani, *&c.* Vol. I. pp. 18, 42, 141, 142, à Paris, 1818.)

As the old argument of the atomical atheists is plainly that on which the school of Diderot are still disposed to rest the strength of their cause, I shall make no apology for the length of this note. The *sceptical* suggestions on the same subject which occur in Mr Hume's *Essay on the Idea of Necessary Connection*, and which have given occasion to so much discussion in this country, do not seem to me to have ever produced any considerable impression on the French philosophers.

NOTE (CC.) p. 133.

AMONG the contemporaries of Diderot, the author of the *Spirit of Laws* is entitled to particular notice, for the respect with which he always speaks of natural religion. A remarkable instance of this occurs in a letter to Dr Warburton, occasioned by the publication of his *View of Bolingbroke's Philosophy*. The letter, it must be owned, savours somewhat of the political religionist; but how fortunate would it have been for France, if, during its late revolutionary governments, such sentiments as those here expressed by Montesquieu had been more generally prevalent among his countrymen! "Celui qui attaque la religion révélée n'attaque que la religion révélée; mais celui que attaque la religion naturelle attaque toutes les religions du monde. . . . . Il n'est pas impossible d'attaquer une religion révélée, parce qu'elle existe par des faits particuliers, et que les faits par leur nature peuvent être une matière de dispute; mais il n'en est pas de même de la religion naturelle; elle est tirée de la nature de l'homme, dont on ne peut pas disputer encore. J'ajoute à ceci, quel peut être le motif d'attaquer la religion révélée en Angleterre? On l'y a tellement purgé de tout prejugé destructeur qu'elle n'y peut faire de mal et qu'elle y peut faire, au contraire, une infinité de biens. Je sais, qu'un homme en Espagne ou en Portugal que l'on va bruler, ou qui craint d'être brulé, parce qu'il ne croit point de certains articles dépendans ou non de la religion révélée, a un juste sujet de l'attaquer, parce qu'il peut avoir quelque espérance de pourvoir à sa défense naturelle: mais il n'en est pas de même en Angleterre, où tout homme qui attaque la religion révélée l'attaque sans intéret, et ou cet homme, quand il réussiroit, quand même il auroit raison dans le fond, ne feroit que détruire une infinité de biens pratiques, pour établir une vérité purement spéculative." (For the whole letter, see the 4to edit. of Montesquieu's *Works*. Paris, 1788. Tome V. p. 391. Also Warburton's *Works* by Hurd, Vol. VII. p. 553. London, 1758.)

In the foregoing passage, Montesquieu hints more explicitly than could well have been expected from a French magistrate, at a consideration which ought always to be taken into the account, in judging of the works of his countrymen, when they touch on the subject of religion; I mean, the corrupted and intolerant spirit of that system of faith which is immediately before their eyes. The eulogy bestowed on the church of England is particularly deserving of notice; and should serve as a caution to Protestant writers against making common cause with the defenders of the church of Rome.

With respect to Voltaire, who, amidst all his extravagancies and impieties, is well known to have declared open war against the principles maintained in the *Sytème de la Nature*, it is remarked by Madame de Staël, that two different epochs may be distinguished in his literary life; the one,

while his mind was warm from the philosophical lessons he had imbibed in England; the other, after it became infected with those extravagant principles which, soon after his death, brought a temporary reproach on the name of Philosophy. As the observation is extended by the very ingenious writer to the French nation in general, and draws a line between two classes of authors who are frequently confounded together in this country, I shall transcribe it in her own words.

"Il me semble qu'on pourroit marquer dans le dix-huitième siècle, en France, deux époques parfaitement distinctes, celle dans laquelle l'influence de l'Angleterre s'est fait sentir, et celle ou les esprits se sont précipités dans la destruction: Alors les lumières se sont changées en incendie, et la philosophie, magicienne irritée, a consumé le palais où elle avoit étalé ses prodiges.

"En politique, Montesquieu appartient à la première époque, Raynal à la seconde; en religion les ecrits de Voltaire, qui avoit la tolerance pour but, sont inspirés par l'esprit de la première moitié du siècle; mais sa miserable et vaniteuse irréligion a flétri la seconde." (*De l'Allemagne*, Tome III. pp. 37, 38.)

Nothing, in truth, can be more striking than the contrast between the spirit of Voltaire's early and of his later productions. From the former may be quoted some of the sublimest sentiments any where to be found, both of religion and of morality. In some of the latter, he appears irrecoverably sunk in the abyss of fatalism. Examples of both are so numerous, that one is at a loss in the selection. In making choice of the following, I am guided chiefly by the comparative shortness of the passages.

"Consulte Zoroastre et Minos, et Solon,
Et le sage Socrate, et le grand Ciceron:
Ils ont adoré tous un maître, un juge, un père;—
Ce système sublime à l'homme est nécessaire.
C'est le sacré lien de la société,
Le premier fondement de la sainte équité;
Le frein du scélérat, l'ésperance du juste.
Si les cieux dépouillés de leur empreinte auguste
Pouvoient cesser jamais de le manifester,
Si Dieu n'existoit pas, il faudroit l'inventer." [1]

Nor is it only on this fundamental principle of religion that Voltaire, in his better days, delighted to enlarge. The existence of a natural law engraved on the human heart, and the liberty of the human will, are subjects which he has repeatedly enforced and adorned with all his philosophical and poetical powers. What can be more explicit, or more forcible, than the following exposition of the inconsistencies of fatalism?

"Vois de la liberté cet ennemi mutin,
Aveugle partisan d'un aveugle destin;
Entends comme il consulte, approuve, ou délibère,
Entends de quel reproche il couvre un adversaire,
Vois comment d'un rival il cherche à se venger,
Comme il punit son fils, et le veut corriger.

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[1] A thought approaching very nearly to this occurs in one of Tillotson's Sermons. "The being of God is so comfortable, so convenient, so necessary to the felicity of Mankind, that (as Tully admirably says), *Dii immortales ad usum hominum fabricati pene videantur.*—If God were not a necessary being of himself, he might almost be said to be made for the use and benefit of Man." For some ingenious remarks on this quotation from Cicero, see Jortin's Tracts, Vol. I. p. 371.

Il le croyoit donc libre ?—Oui sans doute, et lui-même
Dément à chaque pas son funeste système.
Il mentoit à son cœur, en voulant expliquer
Ce dogme absurde à croire, absurde à pratiquer.
Il reconnoit en lui le sentiment qu'il brave,
Il agit comme libre et parle comme esclave."

This very system, however, which Voltaire has here so severely reprobated, he lived to avow as the creed of his more advanced years. The words, indeed, are put into the mouth of a fictitious personage; but it is plain, that the writer meant to be understood as speaking his own sentiments. "Je vois une chaine immense, dont tout est chainon; elle embrasse, elle serre aujourd'hui la nature," &c. &c.

"Je suis donc ramené malgré moi à cette ancienne idée, que je vois être la base de tous les systèmes, dans laquelle tous les philosophes retombent apres mille detours, et qui m'est démontré par toutes les actions des hommes, par les miennes, par tous les événemens que j'ai lus, que j'ai vus, et aux-quelles j'ai eu part; c'est le Fatalisme, c'est la Necessité dont je vous ai deja parlé." (*Lettres de Memmius à Ciceron.* See *Œuvres* de Voltaire, *Mélanges,* Tome IV. p. 358. 4to. Edit. Geneve, 1771.)

Notwithstanding, however, this change in Voltaire's philosophical opinions, he continued to the last his zealous opposition to atheism.[1] But in what respects it is more pernicious than fatalism, it is not easy to discover.

A reflection of La Harpe's, occasioned by some strictures of Voltaire's upon Montesquieu, applies with equal force to the numberless inconsistencies which occur in his metaphysical speculations: "Les objets de méditation étoient trop etrangers à l'excessive vivacité de son esprit. Saisir fortement par l'imagination les objets qu'elle ne doit montrer que d'un côté, c'est ce qui est du Poete; les embrasser sous toutes les faces, c'est ce qui est du Philosophe, et Voltaire étoit trop exclusivement l'un pour ôtre l'autre." (*Cours de Litterat,* Tome XV. pp. 46, 47.)

A late author[2] has very justly reprobated that *spiritual deification of nature* which has been long fashionable among the French; and which, according to his own account, is at present not unfashionable in Germany. It is proper, however, to observe, that this mode of speaking has been used by two very different classes of writers; by the one with an intention to keep as much as possible the Deity out of their view, while studying his works; by the other, as a convenient and well understood metaphor, by means of which the frequent and irreverent mention of the name of God is avoided in philosophical arguments. It was with this last view, undoubtedly, that it was so often employed by Newton, and other English philosophers of the same school. In general, when we find a writer speaking of the *wise* or of the *benevolent intentions* of nature, we should be slow in imputing to him any leaning towards atheism. Many of the finest instances of Final Causes, it is certain, which the eighteenth century has brought to light, have been first remarked by inquirers who seem to have been fond of this phraseology; and of these inquirers, it is possible that some would have been less forward in bearing testimony to the truth, had they been forced to avail themselves of the style of theologians. These speculations, therefore, concerning the *intentions* or *designs of Nature,* how reprehensible soever and even absurd in point of strict

[1] See the *Dict. Philosophique,* Art. *Athéisme.* See also the strictures on the *Système de la Nature* in the *Questions sur l'Encyclopédie*; the very work from which the above quotation is taken.

[2] Frederick Schlegel. *Lectures on the History of Literature.* Vol. II. p. 169. (Edinburgh, 1818.)

logic the language may be in which they are expressed, may often be, nay, have often been, a step towards something higher and better; and, at any rate, are of a character totally different from the blind chance of the Epicureans, or the conflicting principles of the Manicheans.

Note (DD.) p. 153.

"*In the attempt, indeed, which Kant has made to enumerate the general ideas which are not derived from experience, but arise out of the pure understanding, Kant may well lay claim to the praise of originality.*" The object of this problem is thus stated by his friend, Mr Schulze, the author of the Synopsis formerly quoted. (The following translation is by Dr Willich, *Elements*, &c. p. 45.)

"To investigate the whole store of original notions discoverable in our understanding, and which lie at the foundation of all our knowledge; and at the same time to authenticate their true descent, by showing that they are not derived from experience, but are pure productions of the understanding.

"1. The perceptions of objects contain, indeed, the matter of knowledge, but are in themselves blind and dead, and not knowledge; and our soul is merely passive in regard to them.

"2. If these perceptions are to furnish knowledge, the understanding must think of them, and this is possible only through notions (conceptions), which are the peculiar form of our understanding, in the same manner as space and time are the form of our sensitive faculty

"3. These notions are active representations of our understanding-faculty; and as they regard *immediately* the perceptions of objects, they refer to the objects themselves only mediately

"4. They lie on our understanding as pure notions *a priori*, at the foundation of all our knowledge. They are necessary forms, radical notions, categories (predicaments), of which all our knowledge of them mnst be compounded: And the table of them follows.

"*Quantity;* unity, plurality, totality.

"*Quality;* reality, negation, limitation.

"*Relation;* substance, cause, reciprocation.

"*Modality;* possibility, existence, necessity.

"5. Now, to think and to judge is the same thing; consequently, every notion contains a particular form of judgment concerning objects. There are *four* principal *genera* of *judgments*. They are derived from the above four possible functions of the understanding, each of which contains under it *three species;* namely, with respect to

"*Quantity*, they are universal, particular, singular judgments.

"*Quality*, they are affirmative, negative, infinite judgments.

"*Relation*, they are categorical, hypothetical, disjunctive judgments.

"*Modality*, they are problematical, assertory, apodictical judgments."

These tables speak for themselves without any comment.

Note (EE.) p. 154.

Kant's notions of *Time* are contained in the following seven propositions: "1. *Idea temporis non oritur sed supponitur a sensibus.* 2. *Idea temporis est singularis*, non generalis. Tempus enim

quodlibet non cogitatur, nisi tanquam pars unius ejusdem temporis immensi. 3. *Idea* itaque *temporis est intuitus*, et quoniam ante omnem sensationem concipitur, tanquam conditio respectuum in sensibilibus obviorum, est *intuitus*, non sensualis, sed *purus*. 4. *Tempus est quantum continuum* et legum continui in mutationibus universi principium. 5. *Tempus non est objectivum aliquid et reale*, nec substantia, nec accidens, nec relatio, sed subjectiva conditio, per naturam mentis humanæ necessaria, quælibet sensibilia, certa lege sibi co-ordinandi, et *intuitus purus*. 6. Tempus est conceptus verissimus, et, per omnia possibilia sensuum objecta, in infinitum patens, intuitivæ repræsentationis conditio. 7. Tempus itaque est *principium formale mundi sensibilis* absolute primum."

With respect to *Space*, Kant states a series of similar propositions, ascribing to it very nearly the same metaphysical attributes as to *Time*, and running as far as possible a sort of parallel between them. "A. *Conceptus spatii non abstrahitur a sensationibus externis.* B. *Conceptus spatii est singularis repræsentatio* omnia *in se* comprehendens, non *sub se* continens notio abstracta et communis. C. *Conceptus spatii itaque est intuitus purus ;* cum sit conceptus singularis ; sensationibus non conflatus, sed omnis sensationis externæ forma fundamentalis. D. *Spatium non est aliquid objectivi* et realis, nec substantia, nec accidens, nec relatio ; sed *subjectivum* et ideale, e natura mentis stabili lege proficiscens, veluti schema, omnia omnino externe sensa sibi co-ordinandi. E. Quanquam *conceptus spatii*, ut objectivi alicujus et realis entis vel affectionis, sit imaginarius, nihilo tamen secius *respective ad sensibilia quæcunque*, non solum est *verissimus*, sed et omnis veritatis in sensualitate externa fundamentum."

These propositions are extracted from a Dissertation written by Kant himself in the Latin language.[1] Their obscurity, therefore, cannot be ascribed to any misapprehension on the part of a translator. It was on this account that I thought it better to quote them in his own unaltered words, than to avail myself of the corresponding passage in Born's Latin version of the *Critique of Pure Reason.*

To each of Kant's propositions concerning Time and Space I shall subjoin a short comment, following the same order in which these propositions are arranged above.

1. That the idea of *Time* has no resemblance to any of our sensations, and that it is, therefore, not derived from sensation immediately and directly, has been very often observed ; and, if nobody had ever observed it, the fact is so very obvious, that the enunciation of it could not entitle the author to the praise of much ingenuity. Whether "this idea be *supposed* in all our sensations," or (as Kant explains himself more clearly in his third proposition) "be *conceived* by the mind prior to all sensation," is a question which seems to me at least doubtful; nor do I think the opinion we form concerning it a matter of the smallest importance. One thing is certain, that this idea is an inseparable concomitant of every act of memory with respect to past events ; and that, in whatever way it is acquired, we are irresistibly led to ascribe to the thing itself an existence independent of the will of any being whatever.

2. On the second proposition I have nothing to remark. The following is the most intelligible translation of it that I can give. "The idea of Time is singular, not general ; for any particular length of time can be conceived only as a part of one and the same immense whole."

3. From these premises (such as they are) Kant concludes, that the idea of Time is *intuitive*; and that this intuition, being prior to the exercise of the senses, is not empirical but pure. The

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[1] *De Mundi Sensibilis atque Intelligibilis forma et principiis.* Dissertatio pro loco professionis Log. et Metaph. Ordinariæ rite sibi Vindicando ; quam exigentibus statutis Academicis publice tuebitur IMMANUEL KANT.—Regiomonti, 1770.

conclusion here must necessarily partake of the uncertainty of the premises from which it is drawn, but the meaning of the author does not seem to imply any very erroneous principle. It amounts, indeed, to little more than an explanation of some of his peculiar terms.

4. That Time is a *continued quantity* is indisputable. To the latter clause of the sentence I can annex no meaning but this, that time enters as an essential element into our conception of the law of continuity, in all its various applications to the changes that take place in Nature.

5. In this proposition Kant assumes the truth of that much contested, and, to me, incomprehensible doctrine, which denies the objective reality of time. He seems to consider it merely as a subjective *condition*, inseparably connected with the frame of the Human Mind, in consequence of which it arranges sensible phenomena, according to a certain law, in the order of succession.

6. What is meant by calling Time *a true conception*, I do not profess to understand; nor am I able to interpret the remainder of the sentence in any way but this, that we can find no limits to the range thus opened in our conceptions to the succession of sensible events.

7. The conclusion of the whole matter is, that Time is "absolutely the first formal principle of the sensible world." I can annex no meaning to this; but I have translated the original, word for word, and shall leave my readers to their own conjectures.

A. It appears from this, that, in the opinion of Kant, the idea of Space is connate with the mind, or, at least, that it is prior to any information received from the senses. But this doctrine seems to me not a little doubtful. Indeed, I rather lean to the common theory, which supposes our first ideas of Space or Extension to be formed by abstracting this attribute from the other qualities of matter. The idea of Space, however, in whatever manner formed, is manifestly accompanied with an irresistible conviction, that Space is necessarily existent, and that its annihilation is impossible; nay, it appears to me to be also accompanied with an irresistible conviction, that Space cannot possibly be extended in more than three dimensions. Call either of these propositions in question, and you open a door to universal scepticism.

B. I can extract no meaning from this, but the nugatory proposition, that our conception of Space leads us to consider it as *the place* in which all things are comprehended.

C. "The conception of Space, therefore, is a *pure intuition*." This follows as a necessary corollary (according to Kant's own definition) from Prop. A. What is to be understood by the clause which asserts, that Space is the fundamental *form* of every external sensation, it is not easy to conjecture. Does it imply merely that the conception of *Space* is necessarily involved in all our notions of things external? In this case, it only repeats over, in different and most inaccurate terms, the last clause of Prop. B. What can be more loose and illogical than the phrase *external sensation?*

D. That Space is neither a *substance*, nor an *accident*, nor a *relation*, may be safely granted; but does it follow from this that it is nothing *objective*, or, in other words, that it is a mere creature of the imagination? This, however, would seem to be the idea of Kant; and yet I cannot reconcile it with what he says in Prop. E., that the conception of Space is the foundation of all the truth we ascribe to our perceptions of external objects. (The author's own words are—omnis veritatis in sensualitate externa fundamentum!)[1]

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[1] Mr Nitch has remarked this difficulty, and has attempted to remove it. "The most essential objection (he observes) to Kant's system is, that it leads to scepticism; because it maintains, that the figures in which we see the external objects clothed are not in-

Upon the whole, it appears to me, that, among these various propositions, there are some which are quite unintelligible; that others assume, as first principles, doctrines which have been disputed by many of our most eminent philosophers; that others, again, seem to aim at involving plain and obvious truths in darkness and mystery; and that not one is expressed with the simplicity and precision which are the natural results of clear and accurate thinking. In considering time and space as the *forms* of all sensible phenomena, does Kant mean any thing more but this,—that we necessarily refer every sensible phenomenon to some point of space, or to some instant of time? If this was really his meaning, he has only repeated over, in obscurer language, the following propositions of Newton: "Ut ordo partium temporis est immutabilis, sic etiam ordo partium spatii. Moveantur hæc de locis suis, et movebuntur (ut ita dicam) de seipsis. *Nam tempora et spatia sunt sui ipsorum et rerum omnium quasi loca. In tempore, quoad ordinem successionis; in spatio, quoad ordinem situs locantur universa.* De illorum essentia est ut sint loca: et loca primaria moveri absurdum est"

I have quoted this passage, not from any desire of displaying the superiority of Newton over Kant, but chiefly to show how very nearly the powers of the former sink to the same level with those of the latter, when directed to inquiries unfathomable by the human faculties. What abuse of words can be greater than to say, That neither the parts of time nor the parts of space can be *moved* from their *places?*[1] In the *Principia* of Newton, however, this incidental discussion is but a spot on the sun. In the *Critique of Pure Reason*, it is a fair specimen of the rest of the work, and forms one of the chief pillars of the whole system, both metaphysical and moral.

NOTE (FF.) p. 155.

THE following quotation will account for the references which I have made to Mr. Nitsch among the expounders of Kant's Philosophy. It will also serve to show that the *Critique of Pure Reason* has still *some* admirers in England, not less enthusiastic than those it had formerly in Germany.

"In submitting this fourth Treatise on the Philosophy of Kant to the reader" (says the author of these articles in the *Encyclopædia Londinensis*), "I cannot deny myself the satisfaction of publicly acknowledging the great assistance which I have derived in my literary pursuits, from my excellent and highly valued friend *Mr Henry Richter.* To him I am indebted for the clearness and perspicuity with which the thoughts of the immortal Kant have been conveyed to the public. Indeed, his comprehensive knowledge of the system, as well as his enthusiastic admiration of its general truth, render him a most able and desirable co-operator. Should, therefore, any good result to mankind from our joint labours in the display of this vast and profound system, he is justly entitled to his share of the praise. It is with sincere pleasure that I reflect upon that period, now

herent in those objects, and that consequently space is something *within*, and not without the mind." (pp. 144, 145.) "It may be farther objected (he adds), that, if there be no external space, there is also no external world. But, this is concluding by far too much from these premises. If there be no external space, it will follow, that we are not authorised to assign *extension* to external things, but there will follow no more." (p. 140.) Mr Nitsch then proceeds to obviate these objections; but his reply is far from satisfactory, and is indeed not less applicable to the doctrine of Berkeley than to that of Kant. This point, however, I do not mean to argue here. The concessions which Nitsch has made are quite sufficient for my present purpose. They serve at least to satisfy my own mind, that I have not misrepresented Kant's meaning.

[1] Was it not to avoid the palpable incongruity of this language that Kant was led to substitute the word *forms* instead of *places;* the former word not seeming to be so obviously inapplicable as the latter to time and space in common; or, to speak more correctly, being, from its extreme vagueness, equally unmeaning when applied to both?

two and twenty years ago, when we first studied together under the same master, Frederic Augustus Nitsch, who originally imported the seeds of TRANSCENDENTAL PHILOSOPHY from its native country, to plant them in our soil; and though, as is usually the case, many of those seeds were scattered by the wind, I trust that a sufficient number have taken root to maintain the growth of this vigorous and flourishing plant, till the time shall come, when, by its general cultivation, England may be enabled to enrich other nations with the most perfect specimens of its produce. Professor Nitsch, who thus bestowed upon our country her first attainments in the department of *Pure Science*, has paid the debt of nature I confess it is some reflection upon England, that she did not foster and protect this immediate disciple of the father of philosophy; but the necessities of this learned and illustrious man unfortunately compelled him to seek that subsistence elsewhere, which was withheld from him here. At Rostock, about the year 1813, this valuable member of society, and perfect master of the philosophy he undertook to teach, entered upon his immortal career as a reward for his earthly services. It is with the most heartfelt satisfaction that I add my mite of praise to his revered memory. But for him, I might ever have remained in the dark regions of sophistry and uncertainty."

NOTE (GG.) p. 164.

AMONG the secondary mischiefs resulting from the temporary popularity of Kant, none is more to be regretted than the influence of his works on the habits, both of thinking and of writing, of some very eminent men, who have since given to the world histories of philosophy That of Tenneman in particular (a work said to possess great merit) would appear to have been vitiated by this unfortunate bias in the views of its author. A very competent judge has lately said of it, that "it affords, as far as it is completed, the most accurate, the most minute, and the most rational view we yet possess of the different systems of philosophy; but that the critical philosophy being chosen as the vantage ground from whence the survey of former systems is taken, the continual reference in Kant's own language to his peculiar doctrines, renders it frequently impossible for those who have not studied the dark works of this modern Heraclitus to understand the strictures of the historian on the systems even of Aristotle or Plato." * (See the article BRUCKER in this *Supplement.*) We are told by the same writer, that "among the learned of Germany, Brucker has never enjoyed a very distinguished reputation." This I can very easily credit; but I am more inclined to interpret it to the disadvantage of the German taste, than to that of the historian. Brucker is indeed not distinguished by any extraordinary measure of depth or of acuteness; but in industry, fidelity. and sound judgment, he has few superiors; qualities of infinitely greater value in the undertaker of a historical work, than that passion for systematical refinement, which is so apt to betray the best-intentioned writers into false glosses on the opinions they record.

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* When the above passage was written, I had not seen the work of Buhle. I have since had an opportunity of looking into the French translation of it, published at Paris in 1816; and I must frankly acknowledge, that I have seldom met with a greater disappointment. The account there given of the Kantish system, to which I turned with peculiar eagerness, has, if possible, involved to *my* apprehension, in additional obscurity, that mysterious doctrine. From this, however, I did not feel myself entitled to form an estimate of the author's merits as a philosophical historian, till I had read some other articles of which I considered myself as better qualified to judge.

The following short extract will, without the aid of any comment, enable such of my readers as know anything of the literary history of Scotland, to form an opinion upon this point for themselves.

"Reid n'attaqua les systèmes de ces prédécesseurs, et notamment celui de Hume, que parce qu'il se croyait convaincu de leur défaut de fondement. Mais un autre antagoniste, non moins célèbre, du scepticisme de Hume, fut, en outre, guidé par la haine qu'il avoit vouée à son illustre compatriote, *lequel lui répondit avec beaucoup d'aigreur et d'animosité*. James Beattie, *professeur de morale à Edimbourg*, puis ensuite, de logique et de morale, à l'Université d'Aberdeen, *obtint la préférence sur Hume lorsqu'il fut question de remplir la chaire vacante à Edimbourg*. Cette circonstance devint, *sans doute* la principale source de l'inimitié que les deux savans conçurent l'un pour l'autre, et qui influa même sur le ton qu'ils employèrent dans les raisonnemens par lesquels ils se combattirent." (Tome V. p. 235.)

To this quotation may I be pardoned for adding a few sentences relative to myself? "L'ouvrage de Dugald Stewart, intitulé, *Elements of the Philosophy of the Human Mind*, est un syncrétisme des opinions de Hartley et de Reid. Stewart borne absolument la connoissance, tant de l'âme que des choses extérieures, à ce que le sens commun nous en apprend, et croit pouvoir ainsi mettre l'étude de la métaphysique à l'abri du reproche de rouler sur des choses qui dépassent la sphère de notre intelligence, ou qui sont tout-a-fait inutiles dans la pratique de la vie. . . . . Les chapitres suivans renferment le développement du principe de l'association des idées. Ils sont presqu' entièrement écrits d'après Hartley. Stewart fait dériver de ce principe toutes les facultés intellectuelles et pratiques de l'homme." (*Tom. V. pp. 330, 331.*)

Of the discrimination displayed by Buhle in the classification of systems and of authors, the title prefixed to his 19th chapter may serve as a specimen: "*Philosophy of Condillac, of Helvetius, of Baron d'Holbach, of Robinet, of Bonnet, of Montesquieu, of Burlemaqui, of Vattel, and of Reid.*"

But the radical defect of Buhle's work is, the almost total want of references to original authors. We are presented only with the general results of the author's reading, without any guide to assist us in confirming his conclusions when right, or in correcting them when wrong. This circumstance is of itself sufficient to annihilate the value of any historical composition.

Sismondi, in mentioning the history of modern literature by Bouterwek, takes occasion to pay a compliment (and, I have no doubt, a very deserved one) to German scholars in general; observing, that he has executed his task—"avec une étendue d'érudition, et une *loyauté* dans la manière d'en faire profiter ses lecteurs, qui semblent propres aux savans Allemands." (*De la Litt. du Midi de l'Europe*, Tom. I. p. 13, à Paris, 1813.) I regret that my ignorance of the German language has prevented me from profiting by a work of which Sismondi has expressed so favourable an opinion; and still more, that the only history of philosophy from the pen of a contemporary German scholar, which I have had access to consult, should form so remarkable an exception to Sismondi's observation.

The contents of the preceding note lay me under the necessity, in justice to myself, of taking some notice of the following remark on the first part of this *Dissertation*, by an anonymous critic. (See *Quarterly Review*, Vol. XVII. p. 42.)

"In the plan which Mr Stewart has adopted, if he has not consulted *his strength*, he has at least consulted *his ease*; for, supposing a person to have the requisite talent and information, the task which our author has performed, is one which, with the historical abstracts of Buhle or Tenneman, cannot be supposed to have required any very laborious meditation."

On the insinuation contained in the foregoing passage, I abstain from offering any comment. I have only to say, that it is *now*, for the first time (Summer of 1820), that I have seen the work of Buhle; and that I have never yet had an opportunity of seeing that of Tenneman. From what I have found in the one, and from what I have heard of the other, I am strongly inclined to suspect, that when the anonymous critic wrote the above sentence, he was not less ignorant than myself of the works of these two historians. Nor can I refrain from adding (which I do with perfect confidence), that no person competent to judge on such a subject can read with attention this Historical Sketch, without perceiving that its merits and defects, whatever they may be, are at least all my own.

Note (HH.) p. 168.

Of the Scottish authors who turned their attention to metaphysical studies, prior to the Union of the two Kingdoms, I know of none so eminent as George Dalgarno of Aberdeen, author of two works, both of them strongly marked with sound philosophy, as well as with original genius. The one published at London, 1660, is entitled, "*Ars signorum, vulgò character universalis et lingua philosophica, qua poterunt, homines diversissimorum idiomatum, spatio duarum septimanarum, omnia animi sui sensa (in rebus familiaribus) non minus intelligibiliter, sive scribendo, sive loquendo, mutuo communicare, quam linguis propriis vernaculis. Præterea, hinc etiam poterunt juvenes philosophiæ principia, et veram logicæ praxin, citius et facilius multo imbibere, quam ex vulgaribus philosophorum scriptis.*" The other work of Dalgarno, is entitled, "*Didascalocophus, or the Deaf and Dumb Man's Tutor.*" Printed at Oxford, 1680. I have given some account of the former in the notes at the end of the first volume of the *Philosophy of the Human Mind;* and of the latter, in a *Memoir*, published in Vol. VII. of the *Transactions of the Royal Society of Edinburgh.* As they are now become extremely rare, and would together form a very small octavo volume, I cannot help thinking that a bookseller, who should reprint them, would be fully indemnified by the sale. The *fate* of Dalgarno will be hard, indeed, if, in addition to the unjust neglect he experienced from his contemporaries, the proofs he has left of his philosophical talents shall be suffered to sink into total oblivion.

Lord Stair's *Physiologia Nova Experimentalis* (published at Leyden in 1686) is also worthy of notice in the literary history of Scotland. Although it bears few marks of the eminent talents which distinguished the author, both as a lawyer and as a statesman, it discovers a very extensive acquaintance with the metaphysical as well as with the physical doctrines, which were chiefly in vogue at that period; more particularly with the leading doctrines of Gassendi, Descartes, and Malebranche. Many acute and some important strictures are made on the errors of all the three, and at the same time complete justice is done to their merits; the writer every where manifesting an independence of opinion and a spirit of free inquiry, very uncommon among the philosophers of the seventeenth century. The work is dedicated to the Royal Society of London, of the utility of which institution, in promoting experimental knowledge, he appears to have been fully aware.

The limits of a note will not permit me to enter into farther details concerning the state of philosophy in Scotland, during the interval between the Union of the Crowns and that of the Kingdoms. The circumstances of the country were indeed peculiarly unfavourable to it. But memorials still exist of a few individuals, sufficient to show, that the philosophical taste, which has so remarkably distinguished our countrymen during the eighteenth century, was in some measure an inheritance from their immediate predecessors. Leibnitz, I think, somewhere mentions the number of learned

Scotchmen by whom he was visited in the course of their travels. To one of them (Mr. Burnet of Kemney) he has addressed a most interesting letter, dated in 1697, on the general state of learning and science in Europe; opening his mind on the various topics which he introduces, with a freedom and confidence highly honourable to the attainments and character of his correspondent. Dr Arbuthnot, who was born about the time of the Restoration, may serve as a fair specimen of the very liberal education which was then to be had in some of the Scottish Universities. The large share which he is allowed to have contributed to the *Memoirs of Martinus Scriblerus* abundantly attests the variety of his learning, and the just estimate he had formed of the philosophy of the schools; and in one or two passages, where he glances at the errors of his contemporaries, an attentive and intelligent reader will trace, amid all his pleasantry, a metaphysical depth and soundness which seem to belong to a later period.—Is there no Arbuthnot now, to chastise the follies of our craniologists?

NOTE (II.) p. 184.

THE letter which gives occasion to this note was written twenty years after the publication of the *Treatise of Human Nature.** As it relates, however, to the history of Mr Hume's studies previous to that publication, I consider this as the proper place for introducing it. The Dialogue to which the letter refers was plainly that which appeared after Mr Hume's death, under the title of *Dialogues on Natural Religion.*

"DEAR SIR, *Ninewells, March* 19, 1751

"You would perceive by the sample I have given you, that I make Cleanthes the hero of the dialogue. Whatever you can think of to strengthen that side of the argument will be most acceptable to me. Any propensity you imagine I have to the other side crept in upon me against my will; and it is not long ago that I burned an old manuscript book, wrote before I was twenty, which contained, page after page, the gradual progress of my thoughts on that head. It began with an anxious search after arguments to confirm the common opinion; doubts stole in, dissipated, returned, were again dissipated, returned again, and it was a perpetual struggle of a restless imagination against inclination, perhaps against reason.

"I have often thought that the best way of composing a dialogue would be for two persons that are of different opinions about any question of importance, to write alternately the different parts of the discourse, and reply to each other. By this means that vulgar error would be avoided of putting nothing but nonsense into the mouth of the adversary; and, at the same time, a variety of character and genius being upheld, would make the whole look more natural and unaffected. Had it been my good fortune to live near you, I should have taken on me the character of Philo in the dialogue, which you'll own I could have supported naturally enough; and you would not have been averse to that of Cleanthes. I believe, too, we could both of us have kept our tempers very well; only you have not reached an absolute philosophical indifference on these points. What danger can ever come from ingenious reasoning and inquiry? The worst speculative sceptic ever I knew was a much better man than the best superstitious devotee and bigot. I must inform you, too, that this was the way of thinking of the ancients on this subject. If a man made profession of philosophy, whatever his sect was, they always expected to find more regularity in his life and manners than in those of the ignorant and illiterate. There is a remarkable pas-

sage of Appian to this purpose. That historian observes, that, notwithstanding the established prepossessions in favour of learning, yet some philosophers who have been trusted with absolute power have very much abused it; and he instances in Critias, the most violent of the Thirty, and Aristion who governed Athens in the time of Sylla. But I find, upon inquiry, that Critias was a professed Atheist, and Aristion an Epicurean, which is little or nothing different; and yet Appian wonders at their corruption as much as if they had been Stoics or Platonists. A modern zealot would have thought that corruption unavoidable.

"I could wish that Cleanthes's argument could be so analyzed as to be rendered quite formal and regular. The propensity of the mind towards it, unless that propensity were as strong and universal as that to believe in our senses and experience, will still, I am afraid, be esteemed a suspicious foundation. 'Tis here I wish for your assistance. We must endeavour to prove that this propensity is somewhat different from our inclination to find our own figures in the clouds, our face in the moon, our passions and sentiments even in inanimate matter. Such an inclination may and ought to be controlled, and can never be a legitimate ground of assent.

"The instances I have chosen for Cleanthes are, I hope, tolerably happy; and the confusion in which I represent the sceptic seems natural. But, *si quid novisti rectius*, &c.

"You ask me, *if the idea of cause and effect is nothing but vicinity?* (you should have said constant vicinity or regular conjunction)—*I would gladly know whence is that farther idea of causation against which you argue?* The question is pertinent; but I hope I have answered it. We feel, after the constant conjunction, an easy transition from one idea to the other, or a connection in the imagination; and, as it is usual for us to transfer our own feelings to the objects on which they are dependant, we attach the internal sentiment to the external objects. If no single instances of cause and effect appear to have any connection, but only repeated similar ones, you will find yourself obliged to have recourse to this theory.

"I am sorry our correspondence should lead us into these abstract speculations. I have thought, and read, and composed very little on such questions of late. Morals, politics, and literature, have employed all my time; but still the other topics I must think more curious, important, entertaining, and useful, than any geometry that is deeper than Euclid. If, in order to answer the doubts started, new principles of philosophy must be laid, are not these doubts themselves very useful? Are they not preferable to blind and ignorant assent? I hope I can answer my own doubts: but, if I could not, is it to be wondered at? To give myself airs and speak magnificently; might I not observe that Columbus did not conquer empires and plant colonies?

"If I have not unravelled the knot so well in these last papers I sent you, as perhaps I did in the former, it has not, I assure you, proceeded from want of good will. But some subjects are easier than others; and sometimes one is happier in one's researches and inquiries than at other times. Still I have recourse to the *si quid novisti rectius*; not in order to pay you a compliment, but from a real philosophical doubt and curiosity."[1]

An unfinished draught of the letter, to which the foregoing seems to have been the reply, has been preserved among Sir Gilbert Elliot's papers. This careless fragment is in his own handwriting, and exhibits an interesting specimen of the progress made in Scotland among the higher classes, seventy years ago, not only in sound philosophy, but in purity of English style.

[1] The original is in the possession of the Earl of Minto.

"Dear Sir,

"Inclosed I return your papers, which, since my coming to town, I have again read over with the greatest care. The thoughts which this last perusal of them has suggested I shall set down, merely in compliance with your desire, for I pretend not to say anything new upon a question which has already been examined so often and so accurately. I must freely own to you, that to me it appears extremely doubtful, if the position which Cleanthes undertakes to maintain can be supported, at least in any satisfactory manner, upon the principles he establishes and the concessions he makes. If it be only from effects exactly similar that experience warrants us to infer a similar cause, then I am afraid it must be granted, that the works of Nature resemble not so nearly the productions of man as to support the conclusion which Cleanthes admits can be built only on that resemblance. The two instances he brings to illustrate his argument are indeed ingenious and elegant; the first, especially, which seemingly carries great weight along with it: the other, I mean that of the Vegetating Library, as it is of more difficult apprehension, so I think it is not easy for the mind either to retain or to apply it. But, if I mistake not, this strong objection strikes equally against them both. Cleanthes does no more than substitute two artificial instances in the place of natural ones: but if these bear no nearer a resemblance than natural ones to the effects which we have experienced to proceed from men, then nothing *can* justly be inferred from them; and if this resemblance be greater, then nothing farther *ought* to be inferred from them. In one respect, however, Cleanthes seems to limit his reasonings more than is necessary even upon his own principles. Admitting, for once, that experience is the only source of our knowledge, I cannot see how it follows, that, to enable us to infer a similar cause, the effects must not only be similar, but exactly and precisely so. Will not experience authorise me to conclude, that a machine or a piece of mechanism was produced by human art, unless I have happened previously to see a machine or piece of mechanism exactly of the same sort? Point out, for instance, the contrivance and end of a watch to a peasant, who had never before seen anything more curious than the coarsest instruments of husbandry, will he not immediately conclude, that this watch is an effect produced by human art and design? And I would still farther ask, does a spade or a plough much more resemble a watch than a watch does an organized animal? The result of our whole experience, if experience indeed be the only principle, seems rather to amount to this: There are but two ways in which we have ever observed the different parcels of matter to be thrown together; either at random, or with design and purpose. By the first, we have never seen produced a regular complicated effect, corresponding to a certain end; by the second, we uniformly have. If, then, the works of nature, and the productions of man, resemble each other in this one general characteristic, will not even experience sufficiently warrant us to ascribe to both a similar though proportionable cause? If you answer, that abstracting from the experience we acquire in this world, order and adjustment of parts is no proof of design, my reply is, that no conclusions, drawn from the nature of so chimerical a being as man, considered abstracted from experience, can at all be listened to. The principles of the human mind are clearly so contrived as not to unfold themselves till the proper objects and proper opportunity and occasion be presented. There is no arguing upon the nature of man but by considering him as grown to maturity, placed in society, and become acquainted with surrounding objects. But if you should still farther urge, that, with regard to instances of which we have no experience, for ought we know, matter may contain the principles of order, arrangement, and the adjustment of final causes, I should only answer, that whoever can conceive this proposition to be true, has exactly the same idea of matter that I have of mind. I know not if I have reasoned justly upon Cleanthes's prin-

ciples, nor is it indeed very material. The purpose of my letter is barely to point out what to me appears the fair and philosophical method of proceeding in this inquiry. That this universe is the effect of an intelligent designing cause, is a principle which has been most universally received in all ages and in all nations; the proof uniformly appealed to is, the admirable order and adjustment of the works of nature. To proceed, then, experimentally and philosophically, the first question in point of order seems to be, what is the effect which the contemplation of the universe, and the several parts of it, produces upon a considering mind? This is a question of fact; a popular question, the discussion of which depends not upon refinements and subtlety, but merely upon impartiality and attention. I ask, then, what is the sentiment which prevails in one's mind, after having considered not only the more familiar objects that surround him, but also all the discoveries of Natural Philosophy and Natural History; after having considered not only the general economy of the universe, but also the most minute parts of it, and the amazing adjustment of means to ends with a precision unknown to human art, and in instances innumerable? Tell me (to use the words of Cleanthes), does not the idea of a Contriver flow in upon you with a force like that of sensation? Expressions how just! (yet in the mouth of Cleanthes you must allow me to doubt of their propriety.) Nor does this conviction only arise from the consideration of the inanimate parts of the creation, but still more strongly from the contemplation of the faculties of the understanding, the affections of the heart, and the various instincts discoverable both in men and brutes; all so properly adapted to the circumstances and situation both of the species and the individual. Yet this last observation, whatever may be in it, derives no force from experience. For who ever saw a mind produced? If we are desirous to push our experiments still farther, and inquire, whether the survey of the universe has regularly and uniformly led to the belief of an intelligent cause? Shall we not find, that, from the author of the book of Job to the preachers at Boyle's Lecture, the same language has been universally held? No writer, who has ever treated this subject, but has either applied himself to describe, in the most emphatical language, the beauty and order of the universe, or else to collect together and place in the most striking light, the many instances of contrivance and design which have been discovered by observation and experiment. And when they have done this, they seem to have imagined that their task was finished, and their demonstration complete; and indeed no wonder,—for it seems to me, that we are scarce more assured of our own existence, than that this well-ordered universe is the effect of an intelligent cause.

"This first question, then, which is indeed a question of fact, being thus settled upon observations which are obvious and unrefined, but not on that account the less satisfactory, it becomes the business of the philosopher to inquire, whether the conviction arising from these observations be founded on the conclusions of reason, the reports of experience, or the dictates of feeling, or possibly upon all these together; but if his principles shall not be laid so wide as to account for the fact already established upon prior evidence, we may, I think, safely conclude, that his principles are erroneous. Should a philosopher pretend to demonstrate to me, by a system of optics, that I can only discern an object when placed directly opposite to my eye, I should certainly answer, your system must be defective, for it is contradicted by matter of fact." * * * * * *

When this *Dissertation* was nearly ready for the press, the posthumous works of my late very learned, ingenious, and amiable friend, Dr Thomas Brown, were published. The contributions which the philosophy of the human mind owes to his talents and industry, belong exclusively to the literary history of the nineteenth century; and will, I doubt not, receive ample justice from the pens of some of his numerous pupils. On certain points on which we differed in opinion, more particularly on the philosophical merits of Lord Bacon and of Dr Reid, I should have been tempted to offer some additional explanations, if the circumstance of his recent and much lamented death had not imposed silence on me, upon all questions of controversy between us. The state of my health, besides, has been such during the winter, that I have found the task of correcting the press more than sufficient to furnish employment both to my mind and body; and, in fact, I have been forced to deny myself the satisfaction of reading Dr Brown's *Lectures*, till my own performance shall be in the hands of the public.

THE END.

Supplement

TO THE

ENCYCLOPÆDIA BRITANNICA.

H U N

Hungary.

HUNGARY, one of the kingdoms comprehended within the empire of Austria, and the constitution of which is, in some degree, sketched under that article, in the Second Volume of this *Supplement*.

Extent and Boundaries.

It is wholly surrounded by other Austrian states, and bounded on the east by the district of the Seven Mountains, on the north-east by Gallicia, on the north-west by Moravia, on the south-west by Illyria, on the west by Steyermark, and on the south by the military colonies. Its extent is variously estimated by different writers, some making it not more than 86,060 square English miles; whilst Lipsky, the latest geographer, calculates it at 88,940 miles. The whole kingdom lies between the latitude 44° 9', and 49° 46' 20" north, and between longitude 16° 12' and 25° 16' east from London. The Austrian province of Hungary is more extensive than the kingdom of that name, and includes within it the principalities of the Seven Mountains, the military boundaries, and the lands of Dalmatia; but they are not regulated according to the constitution of the kingdom of Hungary, but governed directly by the cabinet of Vienna, with the intervention of the Governor-general of the province.

The kingdom of Hungary, properly so called, is divided into six circles, the names, extent, and population of which are as follows:

	Extent in English Square Miles.	Population in 1805.
1. Circle this side the Danube,	23,595	2,194,390
2. Circle beyond the Danube,	16,896	1,062,2[illegible]9
3. Circle this side the Theisa,	15,510	1,142,626
4. Circle beyond the Theisa,	26,946	1,919,284
5. Province of Sclavonia, .	3,570	287,868
6. Province of Croatia, .	2,262	260,829
	88,779	7,707,2[illegible]

The number of the people here given is that of the conscription lists of 1805, in which the nobility and clergy were not included. The former of those bodies amounted, according to a list twenty years before, to 1[illegible],728, and the latter to 162,49[illegible] males: so that, estimating the females of noble families at the same number, and that neither they nor the clergy had increased or diminished in the preceding twenty years, the whole population in 1805 must have been 8,105,950. In the period that has elapsed since the census was made, an increase must have taken place, as the country has not been the seat of war; and though many of its male population must have fallen in the wide spreading hostilities between Austria and France, the country has been exposed to no such calamitous visitations as tend greatly to check the increase of population. Blumenbach estimated the

number of inhabitants in 1817 to be 8,500,000; and Lichternstern, another statistical writer of great accuracy, coincides with his calculation. By the conscription lists of 1805, the numbers of the sexes appeared to be more nearly equal than is generally found to be the case. The males were 3,759,526, and the females 3,796,394.

Religion and Education.

The majority of the people are Catholics, but the other religious sects are established upon nearly a footing of equality, and have their independent ecclesiastical revenues and discipline. In 1805, the Catholics, including some of the Greek church, and the Armenians who had united with them, were 4,647,832. The Greek church, separate from the Catholics, were 1,161,138, the Calvinists, or Reformed, 1,002,490, the Lutherans 624,776, and the Jews 75,128. The Catholic hierarchy consists of three Archbishops, seventeen diocesan and nineteen titular Bishops; besides Abbots, Priors, and other dignified clergy. The Greek church has one Archbishop, seven Bishops, eighteen Deans, several Abbots, and near three thousand Parish Priests. The Reformed have, in four superintendencies, thirteen hundred ministers; and the Lutherans, in four superintendencies, four hundred and eighty pastors. The education of the people is carefully attended to, as far as regards elementary instruction. Each of the religious sects have their separate institutions for educating those of their confession. The Catholics control one University, five Academies, one Lyceum, two Philosophical Institutes, fifty-five Gymnasiums, six Grammar schools, and nine schools for preparing teachers for the villages, whose number is two thousand six hundred and ninety, and employ three thousand five hundred teachers. The Greeks in union with the Catholics have three hundred and eighty schools, and the same number of teachers. The independent Greeks have two gymnasiums, and twelve hundred and thirty schools, with a master to each. The Reformed have three Colleges, six Gymnasiums, and sixteen hundred schools. The Lutherans have one Lyceum, one College, ten Gymnasiums, and six hundred and thirty schools, with a teacher to each. Thus, for about eight millions and a half of people, the number of institutions for the instruction of the young amount to upwards of six thousand six hundred, and the number of instructors to nearly eight thousand.

Classes of Inhabitants.

The inhabitants are divided into nobles, citizens, and peasants. The first class, though differing in titles and rank, have all equal privileges; the principal distinction betwixt them is, that, in the Assembly of the States, or Diet, the Magnates have personally a seat and vote; and the other nobles vote by their representatives. The higher clergy are considered as nobles, and enjoy like privileges. The nobility can alone possess free lands, or those enjoying the *jus dominale*, and they are exempt from taxes, tithes, and the quartering of soldiers; but, on the other hand, they are bound to perform personal military service, when the pressure of circumstances compels the Diet to decree the levy en-masse, or, as it is called, the INSURRECTION.

The citizens, or burghers, are the inhabitants of those cities which own no superior lord but the monarch. These have privileges similar to the nobility, by which they are exempted from the payment of taxes and tithes, and from the quarterings of the military; and their deputies have seats in the Diet. They are governed by their own magistrates, and manage their own local funds. They cannot, however, hold estates out of their cities, nor institute a suit against the nobles, in their individual names, but only in that of the corporation to which they belong. The peasants generally are slaves, but with a more or less mitigated degree of servitude; and some few, under the denomination of German, or other colonists, are free. The lot of the common peasants has, however, been of late years much improved. They are more protected against the power of their lords, by being allowed to acquire property, by being permitted to leave their estates to their heirs, and to become, if they can do so, burghers of the royal cities. Their condition is, however, still a severe one, as they bear almost all the burdens of the state, and are incapable of commencing suits in the courts against either the nobility or burghers.

Mountains and Face of the Country.

The northern and western sides of Hungary are remarkably mountainous. The Carpathian mountains form a semicircle, extending from the southeast portion of the kingdom till it meets the Danube on the western frontier. In the circle they describe, many projecting ranges extend themselves into the level land. On the western side, the Carinthian mountains cover a considerable portion of the kingdom. The highest points of the Carpathian mountains are the Lomnitzer Spitze, 8.515 feet above the level of the sea; the great Krywan, 8.218; the Caesmark, 8.194; and the Uinacke, 7.597. The loftiest of the Carinthian mass, though it can be scarcely said to be in Hungary, is the Terklou, which is elevated to 10.485 feet. To the eastward of this extend the Norischen and Rhetian Alps, the highest of whose summits, within the Austrian dominions, attains the height of 14.814 feet. The greatest extent of level land in Hungary is found to the eastward of the river Theisa, forming a rich plain of more than 20,000 square miles. Another level, called the Three Cornered Plain, is found to the eastward of the Danube, beginning near Presburg, whose base line extends 150 miles in length. The soil is as various as the elevation of the land; on the mountains it is dry and sterile; on the terraces that surround them, of moderate fertility, and of most luxurious richness on the plains, but mixed with considerable tracks nearly barren, where, for many miles, neither tree, stone, bush, or living creature are to be seen, with sandhills, varying their position with the violent storms that frequently occur.

Cultivation.

Hungary, however, is a country highly productive, yielding the largest proportion of the necessaries of life of any part of the ancient Austrian dominions, and furnishing, from its surplus, large quantities of corn, tobacco, fruit, wine, and cattle, to the neighbouring states. According to the account of Grellman, the extent of land is 39,329,000 jochs, which are nearly equal to an English acre. Of this land only 23,905,126 jochs are in cultivation; the remainder is composed of sandy deserts, lakes, morasses, and barren mountains. The productive lands

Hungary. are thus divided: 4,897,218 arable, 638,767 gardens, 911,176 vineyards, 2,129,225 meadows, 5,536,000 pastures, 850,000 ponds, and 8,940,740 woods. The northern part of Hungary scarcely produces sufficient corn for its own consumption; but the south is the granary, not only for the northern part of the kingdom, but, after deficient harvests, for a great portion both of Germany and Italy. The corn consists of wheat, rye, barley, oats, peas, and in the most southern parts, of rice and maize. Next to the cultivation of corn, the growth of wine is the most considerable object of attention, and managed with the most care. The wines of Tokay have long been celebrated through Europe, and are of the first class of sweet wines; but the wines of Œdenburg, of Rust, and of Ofen, are very highly valued, though but little known beyond the boundaries of the Austrian empire. The whole of the annual produce of wine is estimated by Blumenbach at 4,500,000 hogsheads, and valued at near ten millions Sterling. Notwithstanding the proportion of wood land, the eastern part of the kingdom is much distressed from the want of fuel; but the west furnishes much wood, both for firing and building, and considerable quantities of gall-nuts, turpentine, pitch, tar, and pot and pearl ashes, for the supply of the surrounding countries. The other productions of agriculture, which furnish commerce, are hemp, flax, and tobacco. This last article has been long and successfully cultivated; and that produced in the provinces of Tolna, of Funfkirchen, and in the peninsula of Murakoz, is highly prized for its peculiar aromatic flavour.

Cattle. The breeding of cattle is an important branch of the rural economy of Hungary. The horses, though small, are active and hardy, but, in spite of the measures pursued by the government to improve the races, are still much inferior to those of most parts of the empire. They are generally set to work at too early a period, and their food is usually scanty and bad. They have, however, been somewhat improved of late years, by the institution of studs in different parts, whence stallions are gratuitously supplied. The whole number of horses does not exceed 180,000, of all kinds. The horned cattle are a race much valued in every part of the empire, though they receive but little attention. The extensive *Steppes* between Debretzen, Temeswar, Neusatz, and Pest, are the native homes of these beasts. Their number was 886,900 oxen, and 1,508,100 cows. These, by their sale to the surrounding countries, produce annually near L.500,000 Sterling. The numbers of the sheep are stated to be upwards of 8,000,000. There are prodigious flocks on the plains between the Danube and the Theisa, and on the elevated grounds of that district. The wool is coarse, and the owners estimate the cheese, milk, and flesh, more than the fleeces. In Western Hungary, on the other hand, the large flocks have been much improved of late years, by crosses with the Merino breeds, and with the sheep of Padua, yield fine wool, which, to the value of L.500,000, is exported. Swine are reared in abundance; and though, when cured, they form the principal animal food of the inhabitants, there are yearly from 200,000 to 250,000 of these animals exported. The feathered tribes furnish a part of the annual wealth of the country. The greater part of the goose feathers, in which the Jews of Prague trade, come from Hungary; and the capital of the Austrian dominions is supplied from thence with that commodity. The rearing of silkworms has been of late much attended to, in some of the southern parts of Hungary, especially in the Banat. The mulberry trees are very flourishing, and great progress is expected in future, but the undertaking is yet in its infancy.

Minerals. The southern part of Hungary is a country enriched by minerals of various kinds. About two-thirds of the mines belong to the crown, and are worked on account of the government, under an expensive system of administration, and with a profusion of royal officers. These are formed into four divisions, the principal seats of which are at Chemnitz, Schmolnitz, Nagybanja, and Oravicza, and employ, in the various operations, about 45,000 workmen. The labourers, occupied in these mining operations, are generally emigrants from Moldavia and Wallachia. The whole produce of the mines, as well as the varying accounts of André and of Schwartner can be reconciled, average, in a series of years, as follow:

Gold, . .	16,800	ounces.
Silver, . .	686,500	do.
Copper, . .	58,000	quintals.
Lead, . .	24,000	do.
Iron, . .	192,000	do.
Quicksilver, .	130	do.
Antimony, . .	5,250	do.
Cobalt, . .	5,000	do.
Calamine, . .	500	do.
Alum, . .	1,800	do.
Natron, .	15,000	do.
Salt, . .	47,000	tons.
Coals, . .	30,000	do.

Manufactures. The manufactures of Hungary are yet in an infant state. The kingdom has been long accustomed to supply raw materials to the surrounding countries, and to draw from them their manufactured goods. The inhabitants are not disposed to labour in confined houses; and, till within the last twenty years, their principal occupation, exclusive of agriculture, was confined to making very coarse cloths, and various kinds of wood ware, for furniture, musical instruments, and toys. The spinning of flax is a domestic manufactory carried on by the females of almost every peasant's family; the annual quantity produced is estimated at sixteen million of ells, or about ten million yards, the far greater part of which is consumed within the kingdom. The principal bleaching works are at Rosenau, where about 300,000 ells are annually whitened, all of the finer kind. There is much woollen cloth made in small manufactories scattered over the whole kingdom, which is of a coarse quality, and adapted for the use of the peasantry. Within the last thirty years more extensive factories have been established in Gacs, Illawa, Kaschau, Munkatsch, Lipersdorf, Mosztenie, and Presburg. These have been mostly founded by Germans, and the greater part of the operative people are of that nation. At these places the use of vari-

ous machinery has been introduced, and the cloth made in them, from the wool of a mixed breed of sheep, partly of the Merino and partly of the Paduan races, is of fine quality and well finished. There are forty paper-mills in Hungary which produce printing and writing paper, all of a very wretched quality, except some from the mill belonging to the University, which is tolerably good. Silks and ribbons are made at Pest, Groswarden, and Presburg, but to a very small extent. The leather of Hungary is much valued through the whole Austrian territories, but the quantity of curried leather, prepared mostly at Presburg, is not equal to the consumption, and the hides of their cattle are sent to Germany, from whence they return in a state fit for use; the tanneries are numerous in Presburg, Funfkirchen, Ratko, Zips, and Debreczyn. The iron produced by the native mines is manufactured into the various articles which the wants of the inhabitants require, at Zips, Abouigvar, Sarosch, Zemplin, Vorschod, and through the whole county of Gomorer. The best steel is made in Diosgyvor, and the vicinity of Neusol; and the swords and other weapons manufactured in the different hard-ware districts are esteemed to be of excellent quality, though of clumsy and grotesque forms. Glass is made (but scarcely any but green) in twenty-five glass-houses in different parts of the kingdom. The sugar refiners supply the domestic consumption. Snuff and tobacco are made almost exclusively from the plants raised on their own soil. The soap of Hungary, which is very good, is principally made from natron in Debreczyn, where there are seventy-eight manufactories of that article. Linseed-oil, oil of turpentine, corn spirits, cordials, especially Rosiglio, and a medicine for wounds, known through Germany by the name of the Hungarian Balsam, refined saltpetre, and pearl ashes, are the productions of the other manufactories.

Commerce. Hungary is surrounded on every side by the other Austrian dominions. The states of that country are proud of their independence as a separate kingdom, and tenacious of their privileges especially of their exemption from the taxes imposed by the Cabinet of Vienna. As the Emperor's government has no wish to embroil itself with the states by attempting internal taxation, it extracts a revenue by surrounding Hungary with customhouses, where tolls are collected on every commodity that enters into the kingdom, or passes from it into the hereditary states. The toll thus collected is one-thirtieth part of the commodity, or three and a third *per cent.* on the value of it. The very high rate of carriage arising from the bad state of the roads is, however, a greater impediment to the exchange of commodities than even this tax at the frontiers. The principal trade of Hungary, beyond the immediate boundaries, is with Poland and Silesia, which countries draw their wine from thence; and with the north of Italy, to which its surplus corn is transported. The port of Fiume is connected with Hungary by the only good roads the kingdom possesses, and may be considered as its haven for exportation and importation, and as alone bringing it into contact with distant countries. The central point of internal trade is Pest, where, at four great fairs, the concourse of buyers and sellers is so great, that the prices settled by them, if they do not absolutely govern, in a great degree regulate those of the other parts of the kingdom. From the central city the commerce diverges in four great branches; 1*st*, Towards the German Austrian dominions by Raab, Presburg, Komorn, and Oedenburg, at each of which places considerable business is transacted, 2*d*, Toward Gallicia, through Kaschau, Eperies, and Leutschau; 3*d*, To Sieberbirgen, Moldavia, and Wallachia, through Lebreczyn, Ezegedin, and Temeswar; and, 4*th*, To the Turkish dominions beyond the Danube, through Neusatz and Semlin. At all these places considerable annual fairs or markets are held, which are resorted to by vast numbers of merchants, not only from Germany and Poland, but by the Turks, Armenians, Greeks, and even Tartars. Besides the marts at these cities, there are in Hungary sixteen hundred other places where annual fairs are held. The means of internal transit furnished by the rivers are a great assistance to commerce. The Danube is navigable for craft of two hundred tons burden, the Theisa for those of one hundred, and the other rivers, the Save, the Drave, the Waag, the Gran, the Unna, and the Kulpa, are all navigable to smaller vessels of various capabilities. Although the roads generally are miserably bad, yet some have been constructed for the purposes of trade, called *Komerzialstrasse*, which, commencing at Pest in six different directions, cross the kingdom. Though not very good, or only so when compared with the other roads, they afford communications; but the want of bridges over the different rivers makes every removal of commodities both dilatory and troublesome. The paper money which Austria circulates through all her dominions, and which is greatly depreciated, when compared with the precious metals that are used as measures of value in all the other parts of Europe, makes any returns in the amount of exports and imports very indefinite, without going back to a period prior to any sensible depreciation. We have, therefore, extracted from various accounts the amount of the trade of Hungary for the year 1802. Since that time the apparent amount has been swelled in figures, but, as the paper has fallen in value, it has created an illusive increase without any correspondent one in intrinsic value. The fluctuations in the relative value of the paper money have been very great, so that, without knowing its precise relation to metallic money at the given periods, any accounts of the extent of the trade at those periods must be as uncertain as the then value of the currency.

Trade of Hungary in 1802.

	Exports in Gulden.	Imports in Gulden.
Cattle, ...	8,483,493	682,171
Corn and other fruits of the fields, . . .	2,816,338	266,554
Other eatables, . .	412,255	290,802
Honey and wax, . .	203,865	3,275
Carry forward,	11,915,951	1,242,802

Hungary.

	Exports in Gulden.	Imports in Gulden.
Brought forward,	11,915,951	1,242,802
Various drugs, . .	719,032	2,790,280
Tobacco, . .	1,143,189	2,993
Liquors, principally wine,	2,486,305	219,989
Mineral productions, .	637,491	1,299,235
Wood wares, . . .	96,687	319,885
Earthen ware and porcelain,	16,066	170,683
Printed books and stationary,	32,371	117,241
Haberdashery, including rags, tobacco pipes, turnery, &c. &c. &c. . . .	255,414	264,410
Ready made clothes, .	101,178	221,899
Wool and woollen goods, .	5,059,557	1,668,068
Cotton goods of all kinds, .	85,034	1,611,564
Hemp, flax, and linen goods,	171,909	2,692,265
Yarn, ...	63,874	230,583
Silk and silk goods, . .	161,789	1,223,991
Hides and skins, . .	1,915,213	918,314
Various natural productions, as feathers, quills, horse-hair, bristles, &c. &c. &c.		114,602
Various small articles, as hair sieves, leather belts, brushes, brooms, &c. &c. &c. .	16,718	218,367
Total in gulden about 1/10th of the pound Sterling,	24,514,96[illegible]	18,390,111

The balance of commodities between Hungary and the other parts of the Austrian dominions is thus, 6,124,878 gulden, or about L.6[illegible]0,000 in favour of the former.

The government of Hungary is a limited monarchy, hereditary in the house of Hapsburg at present; but, in case of the failure of all the branches of that family, the king, or rather dynasty, becomes elective by the assembled states or diet. The laws by which the constitution was founded, and by which it is maintained, are the *Golden Bull* of their king Andrea II., dated in 1222, the Magna Charta of the nobles, whose privileges are principally regarded; and these have been confirmed by the peace of Vienna in 1606, and of Lintz in 1647. By these two treaties also the free exercise of their religion is secured to the Protestant sectaries. All these interests were further confirmed by the diet of Presburg in 1687, and by the inauguration diploma of Leopold II. in 1790. These various charters and acts of the states have merely secured to the privileged orders their various ancient rights, but have left the peasantry, the great mass of the population, in the same state of subjection as before their promulgation.

The King

The whole executive power is vested in the monarch. He is the source of all titles and offices, nominates to the higher ecclesiastical dignities and to the benches of justice. He makes war and peace, can call together and dissolve the diet, and draw forth the whole military population. He receives the incomes of all vacant ecclesiastical benefices, and is heir to the property of such noble families as become extinct. The direction of the universities and colleges belongs to the King, but to the higher offices in them he can only appoint those who are of noble birth. The appeals to Rome on the affairs of the Catholic church can only be made through him, and the royal authority has been constantly exercised to contract the number and limit the causes of such applications. The King must be of the Catholic religion, and, at his inauguration, must swear to maintain the privileges and rights of the states; notwithstanding this oath, by various circumstances, many arising out of the late long wars, the power and influence of the Crown have been recently very much extended. Within six months after succeeding to the throne, the King must call together the states, and in their presence, in the open air, swear to maintain the privileges of the states, to leave the crown of St Stephen within the kingdom, and to allow the states to elect a King, upon failure of issue both male and female of the Emperor Charles VI. Joseph I. and Leopold I. During a minority, the Palatine is guardian of the King and kingdom; but the monarch is capable of assuming the exercise of power when he has completed his fourteenth year.

States

The States of Hungary *(status et ordines)* consist of, 1*st*, The Prelates, to which class belong the Archbishops, Bishops, Abbots, and Priors of the Greek and Catholic Churches; 2*d*, The temporal Barons and Magnates, the High Bailiffs of the provinces, and the Counts and independent noble proprietors of estates; 3*d*, The Nobility, or Knights, who do not attend personally, but choose two deputies for each county *(Komitat)* or province; and, 4*th*, The Deputies from the royal cities. These members are said to be the representatives of Hungary, whilst the mass of the inhabitants, in their law described as *misera plebs contribuens*, have no connection with public affairs, except by paying taxes and furnishing recruits; from both of which services the nobles and clergy are exempt. The purposes for which the States assemble are the coronation of the King,—the election of a Palatine,—the admission to or exclusion of nobles and cities from their rank,—the granting subsidies and imposing taxes, and the framing new laws, or rather giving the assent of the assembly to such laws as the King may enact. By the constitution, the States should be convened every five years, or whenever any pressing circumstances require their assembling. Of these circumstances the King must judge, as the States are only convened by his summons. They meet in two chambers, or, as they are denominated, tables. The Magnates' table is composed of the royal barons, the high hereditary officers of the kingdom, and the prelates, counts and free landlords. The other chamber, called the States' table, consists of the deputies of the *Komitats*, or the supleans of the nobles, the representatives of the royal free cities, and the persons appointed by such Magnates as do not attend, who are called *Ablegati absentium*. Though the States meet but in two chambers, yet they vote in four distinct bodies, and the absolute majority of those present determine each question in that body. If the King and three of these bodies determine any point, it becomes a law; and the fourth body has no suspending power. The King appears personally, or by his commissioner, and claims his pre-

rogatives, and the States demand a confirmation of their rights. At the Diet in 1792 were present 30 Bishops and other ecclesiastics, 178 Counts, 131 Hereditary Officers and Barons, 16 Law Officers, 30 Deputies of Chapters, 98 Representatives of *Komitats*, 115 Supleans of absent Magnates, and 82 Deputies of Cities. The sitting of the Diet depends on the King, who has usually dismissed them as speedily as possible, out of regard to the general welfare of the people. During the meeting of the Diet, all the courts of justice are shut up, and the deputies of the free cities and of the *Komitats* are maintained at the time of the session at the expence of the people who send them, whilst the hereditary officers are kept by the Crown. From these regulations, it is not to be wondered at that no anxiety for the meeting of the Diet is manifested by any part of the kingdom. The King is well aware that no considerable sum beyond what is necessary for the expences of the local government, will be often granted by the Diet; and when it is granted, as the whole is squeezed from the hard earnings of the peasants, it is collected with difficulty, and produces great oppression. As each *Komitat* has its own provincial Diet, in which its affairs are discussed and regulated, and to which appeals from the courts of justice of the nobles *(Herren Stuhls)* can be made, there is less occasion for the assembling of the general Diet; and though, by the constitution, that body should meet every five years, yet, by a general acquiescence, its periodical convocation has been of late dispensed with. Whenever the Diet is convoked, the summons of the monarch states the purposes for which they are to meet, in the orders to these subordinate diets; and no other proposition is or can be produced at the assembly. The local diets thus have an opportunity of discussing the propositions that are to be made to the general assembly, of determining what part to take, and of instructing their deputies in what manner to vote. No project of a new law originates with any of the States; and the sittings, though they have been formerly very stormy, have been, of late, rather in compliance with ancient forms, and for purposes of display, than for any objects of great utility.

Great Officers.

The principal officer of the kingdom is the Palatine, who is the representative of the King, president of the Diet, and of the Supreme Court of Justice, dispenser of pardons, and mediator between the Monarch and the States; his office continues but one year, but he may be re-appointed. Next to him is the Judge of the Supreme Court, who is the president of the other two, and fills the office of Palatine in the absence of that chief. The Ban of the Croats follows next in rank, but has no official duties unless at the coronation, when he carries the golden ball. The hereditary treasurer *(Tavernicus)* has a seat in the supreme council, and is Captain of the noble Hungarian Body Guards, w... perform the palace duty.

Chancery Court.

The administration is conducted by the Emperor through the means of the Hungarian Court of Chancery in Vienna, which is constituted of twenty-four state-councillors, viz. three ecclesiastics, eleven magnates, and ten of knightly rank, all nominated by the monarch. This college exercises the superintendence over churches, schools, and charitable establishments, administers the funds of the universities and convents, and regulates the agriculture, the trade, and the feudal claims. This body has no original jurisdiction in matters of finance or of justice, but may be appealed to by the provincial diets, or the local courts of law.

Oppressed State of the People.

The primary courts of law are under the control of the nobles, who appoint the judges and direct the procedure. The oppression in such courts towards those not noble has been long excessive, and, though somewhat mitigated since the reign of Maria Theresa, bears still the deep impression of the worst periods of the feudal government. The whole system of laws seems calculated only to secure and perpetuate to the nobles the enormous power they possess. The nobles are exempt from all taxes and imposts of every kind; the only duty they owe to the state is that of personal service in war. If a person not noble assaults one who is so, the legal punishment is death, which is, however, now usually commuted into the forfeiture of all his property, with the privilege of reclaiming it whenever he shall have the means of paying for it a stipulated portion of the value. If a peasant is injured by a noble, to whose estate he is attached, he can have no redress, since he can only sue for it in the name and through the medium of the very person against whom he seeks it. The court in which his complaint is to be heard, not only consists of persons who are generally the dependants of the presumed offender, but moreover they can only be assembled at his summons. If a peasant is injured by any other noble, he cannot seek redress in his own person, but only through the intervention of him on whose estate he lives; and such is the contempt in which the peasantry are held, that even this privilege must very often be nugatory. The law of entail is another injurious privilege of the nobility, common, indeed, to all the feudal countries, which puts it out of their power to alienate the estates to the detriment of the successors. The effect of this is, that the possessions of the nobles are of enormous extent, embracing, often, whole *Komitats;* and they are held upon tenures which convert them into the nature of principalities. The kingdom, indeed, partakes more of the nature of a great military confederation of subordinate chiefs, under one hereditary leader, than of any other known form of government. As all the descendants of noble families are themselves noble, whilst property remains almost unalienable, the poverty into which individuals belonging to distant branches of these families fall is in proportion to their number. In Hungary, it is estimated that one person in twenty is of noble birth, all possessing the obnoxious privileges here noticed; many of them, though free from all taxes, sunk to a state of most abject poverty, and some of them filling the offices of peasants or servants. The inhabitants of the free cities are supposed to be about equal in numbers to the nobility, and the remainder of the people, according to these estimates, amounting to eighteen

Hungary. out of every twenty, can have no protection from the laws, nor any resource when injured or oppressed by their superiors. "The noble," says Dr Bright, "pays no tribute, and goes freely through the country, subject to neither tolls nor duties; but the peasant is subject to pay tribute, and although there may be some nominal restrictions to the services due from him to the government, it can safely be said, that there is no limit, in point of fact, to the services which he is compelled to perform. Whatever public work is to be executed,—not only when a road is to be prepared, but when new roads are to be made, or bridges built, the county meeting gives the order, and the peasant dares not refuse to execute it. All soldiers passing through the country are quartered exclusively upon the peasantry. They must provide them, without recompence, with bread, and furnish their horses with corn, and whenever called upon, by an order termed a *forespan order,* they must provide the person bringing it with horses and means of conveyance. Such an order is always employed by the officers of government; and whoever can in any way plead public business as the cause of his journey, takes care to provide himself with it. In all levies of soldiers, the whole falls upon the peasant, and the choice is left to the arbitrary discretion of the lord and his servants."

From the same intelligent traveller we learn, what, indeed, the observations of all ages has taught, that whilst the nobles are hospitable, high-spirited, well informed, and zealous to promote such institutions and projects as they think calculated to benefit their country, the peasantry are not only poor but idle, dissolute, and dishonest. Perhaps in no other country of Europe is highway robbery so frequent; and, as a remarkable trait in the character both of the noble and the peasant, we are told, that to every nobleman's house a prison is attached, in which are to be constantly found from ten to twenty miserable wretches, pinioned in a way which would not be tolerated in England towards the worst felons. The dungeons in which they are immured are far more dismal and wretched than any prison in London can exhibit. The extreme viciousness of the Hungarian peasantry seems to have extinguished all feeling in the breasts of the higher nobles for their degraded state; and instead of the wise policy, which, by meliorating their condition, would improve their morals, they are left to endure those punishments which a different state of society would be likely to render unnecessary.

Finances. In speaking of the finances of the Hungarian government, a difficulty arises from the state of the currency. In the whole of the Austrian dominions, the currency is paper money issued by the monarch, which has gradually depreciated, and, by affecting the prices of all commodities, has rendered them variable, and extended those variations to the public revenue; hence the accounts of the national income, given by different writers, are excessively discordant. According to the best view we can take, the revenue, if reduced into metallic money, would amount to nearly L.2,000,000 Sterling, the greater part of which is expended by the local diets of the several *Komitats,* and a very small portion is remitted to Vienna. This revenue is derived from the following sources: 1. The royal domains; 2. The regalia, among which the most considerable are the salt mines and salt springs, and in which is included the coinage, the mines, the toleration tax on the Jews, the profits on posting, and the revenues of the vacant ecclesiastical benefices; 3. The land-tax levied on the peasants, which amounts to nearly L.400,000 Sterling; and, 4. The profits arising from loans of money by the royal banks.

Military Force. The military force raised by Hungary consists of twelve regiments of infantry of 3857 men each, and ten complete Hussar regiments of 1698 men each, making together 63,364 regulars, which are recruited from among the peasantry, and are much increased in time of war, when danger threatens the country, and what is termed the insurrection is called forth. In 1797, this irregular force was 18,000 cavalry and 35,000 infantry; in 1800, it was 11,000 horse and 26,000 foot; and, in 1809, 18,000 horse and 21,000 foot. From being tenacious of their privileges, and from the organization and the ranking of the different portions of this noble force, being partly under the control of the monarch, and partly under that of the diets, it has never been found very efficient when engaged in field operations.

The southern frontier on the boundary of the Turkish empire is planted with a military colony, who hold the lands they cultivate upon the terms of being always ready for active service when a war breaks out with that power. Though scattered on different small farms, they are all regimented, and have been drilled, so that they are capable of affording some defence against such undisciplined bodies as the Turks usually employ in their predatory irruptions.

Language and Literature. Though Hungary has a national language, yet it is not generally spoken, nor supposed to be understood by more than one-third of the inhabitants. The only written language, until within a very late period, was the Latin, in which all their laws and public proceedings were promulgated; and it is still the most common medium of communication. It was not till the reign of Maria Theresa that any experiments were made to improve and polish the national language. When she formed her Hungarian guards, a number of young men of noble families were drawn to Vienna, where they had means of knowing the estimation in which the cultivation of learning was held in the more civilized parts of Europe, and were taught to feel the inferiority of their native country, in not possessing a national language and national literature. This stimulated them to exertions to remove the stigma, and give birth to most of those writings of which the Hungarians boast. The cultivation of the vernacular tongue was further promoted by the attempt of the Emperor Joseph to introduce the German tongue into their public transactions; this roused the patriotic spirit of the Hungarians, and the effect of that spirit became visible in the extension and improvement of the native language. Since that period the study of this language has produced some good poets, who have generally dedicated their powers to the praises of their country, and to recording the merits of its most distin-

Hungary. Huntingdonshire.

guished natives. As the subjects of their poetry are very little known beyond the limits of the country, we must trust to the reports of those who feel the most interest in the subjects of which it principally treats, and who, for that reason, may not be the most unbiassed critics.

The inhabitants of Hungary, for the greater part, live in villages, and those residing in the cities and towns are not supposed to be more than a twentieth of the whole number. The principal cities, and their population in 1817, were,

Pest,	41,882
Debreczyn,	38,962
Ofen or Buda,	27,130
Presburg,	26,240
Ezegeden,	25,692
Theresianstadt,	24,109
Schemnitz,	20,241
Versetz,	16,200
Erlau or Eger,	16,112
Zombor,	15,109
Mischkoltz,	13,557
Neusatz,	13,395
Stuhlweissenburg,	12,244
Oedenburg,	11,827
Temeswar,	11,098
Komorn,	11,065
Bekes,	11,022
Neusal,	10,069
Miava,	10,064
Kremnitz,	9,678
Telegyhaza,	9,405

See M. Schwartner, *Statistik des Königreichs Ungarn*, 1809.—*Diarium Comitiorum Regni Hungar*, 1807, *indictorum Pesth*, 1808.—Link, *Kleine Geographie des Konigreich Ungarn*. Wien, 1817 and 1818. —Bright's *Travels through Lower Hungary*. London, 1818. (W. W.)

Extent and Boundaries.

HUNTINGDONSHIRE, an inland county of England, and, except Rutlandshire, the smallest of the whole. It is bounded on the north-east and east by Cambridgeshire, on the north-west and west by Northamptonshire, and on the south by Bedfordshire. Its greatest breadth is twenty-three miles, and its greatest length thirty miles, and its square contents are 350 miles.

Towns and Population.

It is divided into four hundreds, containing six market towns, and 104 parishes, in which are 7719 houses. At the census of 1811 the number of inhabitants was 42,208, viz. 20,402 males, and 21,806 females. The baptisms of the preceding year were 613 males and 591 females, the burials 446 males and 404 females, the marriages were 357. The number of families were 8808, of whom 5361 were employed in agriculture; 2205 in trade and manufactories; and 1242 in various occupations. The towns containing more than 1000 inhabitants are as follow:

Towns.	Houses.	Inhabitants.
Huntingdon,	471	2397
St Ives,	489	2426
Ramsey,	484	2300
St Noets,	408	1988
Godmanchester,	408	1779
Kembolton,	262	1400
Gaxley,	171	1391

Four members are returned to Parliament, viz. two for the county, and two for the borough of Huntingdon.

Face of the Country.

The appearance of the county is of three descriptions. In the south-east it is an extensive plain of rich meadow land, the middle varying in its surface with gentle undulations, and without many inclosures or many woods; the higher part was anciently a forest, and still contains a great extent of woodland, whose foliage gives beauty to the scenery. On the north-eastern side a portion of the county is fine land, comprizing a part of what is commonly called Bedford level, comprehending nearly one-fifth of the whole county.

Rivers and Lakes.

The two most considerable rivers are the Ouse and the Nen. The Ouse enters from Bedfordshire, and crossing the whole of the county, passes into Cambridgeshire in its way to the German Ocean. It is navigable in its whole extent through Huntingdonshire, and forms an important means of intercourse. The Nen enters from Northamptonshire, and runs to the marshes; it is also navigable the greater part of its course. Besides these, the Cam passes through a part of the county. There are three lakes, viz. Whittlesea mere, Ramsay mere, and Ugg mere; the first of these is the largest, and covers an area of several miles in extent. It affords excellent fishing, and pleasant sailing, which induces many parties of pleasure to visit it in the summer season. Projects for draining this lake have been formed, as the water is not deep, and the soil excellent; but they have not yet been carried into execution.

Commerce.

The county of Huntingdon scarcely contains any manufactures, excepting some spinning, performed by the females; but the improvements of machinery in other districts have much diminished that mode of employment. The only trade is that of corn, cattle, and the wool of the few flocks of sheep.

Agriculture.

Agriculture is the principal pursuit of the district. The marshes and meadows are highly productive, and many oxen are fattened on them, without any other food than their natural grass. Much of this land is under the plough, and produces most abundant crops of oats and coleseed; the mills for making the latter into oil are numerous. The hay from those fens is very considerable, but on the banks of the rivers they are subject to great floods, which sometimes destroy the harvest of the year. Though these lands are very valuable, yet the expence of draining them causes a great deduction from their value.

The soils in the upland parts of the county are various, but consist principally of a tenacious clayey loam, or of a deep gravelly loam with some clay. Much of this is in open common fields, where each occupier is compelled to follow a rotation like that of his neighbours. On the best of these lands the usual course of cropping is a year's fallow, then wheat or barley, next beans, and then barley or wheat. On

the land of a quality somewhat inferior, a three course rotation of fallow, wheat, and peas or beans, is pursued. In those fields that are calculated for turnips, that root is succeeded by barley and wheat, or by wheat and barley. The average produce of the lands is stated at five quarters of barley, four of oats, and three and a half of wheat to the acre. The excellent practice of sowing clover between two corn crops is followed to a very small extent. The farms are generally small, few rentals exceed L.200 *per annum*.

The sheep of Huntingdonshire are a mixed race, composed of crosses of the Lincolnshire and Leicestershire breeds, with the native kinds. They are without horns, of very imperfect shape, but are found profitable from the quantity of wool they produce; their fleeces usually weighing from seven to eight pounds each. The sheep of the original race of the county are much inferior to those produced by the crossing with the better kinds; many of these are still found in the open commons, and their fleeces seldom exceed four pounds in weight. The cows are bred with little attention, and are a compound of many races. Very little butter or cheese is made; the principal object being the suckling of calves to supply veal for the London markets. Many horses are bred in the lower part of the county, but without much attention to their races. From this practice of breeding, it has become very general to execute all the agricultural work with mares.

The remains of antiquity in this county are principally of Roman origin; among them are the vestiges of the three roads, which were constructed by that people across the country. The remains of Ramsey Abbey and Castle, the seat of the family from which Oliver Cromwell, a native of this county, sprung, are of venerable date. The monks who formerly occupied it were highly celebrated for their knowledge of the Hebrew language. The churches of Bluntisham, St Ives, and St Neots, and the Castle of Kimbolton, exhibit marks of high antiquity.

The most remarkable noblemen and gentlemen's seats are, Kimbolton, Duke of Manchester; Bucden Palace, Bishop of Lincoln; Connington Castle, J. Heathcote, Esq.; Elton, Earl of Carysfort; Hinchinbroke, Earl of Sandwich; Overton Longueville, Earl of Aboyne; Gains Hall, Sir James Duberly; Place, P. Stanley, Esq.; Ramsey, William Fellowes, Esq.; Stirtloe, Launcelot Brown, Esq.; Stoughton, Earl Ludlow; and Upwood, Sir Richard Bickerton.

See Brayley's *Beauties of England and Wales.*—Stone's *General View of Huntingdonshire.*—And *Population Returns.* (W. W.)

HYDRAULICS. In addition to the general principles of Hydraulics, as they have been detailed in the article HYDRODYNAMICS, of the *Encyclopædia*, it will be necessary to give some accounts of the later attempts that have been made to improve the theory of this department of science, especially those of Mr De Prony, contained in his *Recherches Physicomathématiques sur la Théorie des eaux courantes*, 4to. Paris, 1804; and those of Dr Thomas Young, in his *Hydraulic Investigations*, published in the *Philosophical Transactions* for 1808.

Ingenious and important as the Chevalier Dubuat's theory of the friction of fluids is admitted to have been, it cannot be denied, that it is extremely deficient both in the distinct elucidation of the physical grounds of the phenomena, and with respect to the neatness and simplicity of the methods of calculation. Mr Girard, according to Mr De Prony, was the first who entertained the fortunate idea of applying the theory of Mr Coulomb to the resistance of water flowing in pipes and canals; and in his two memoirs on the *Theory of Running Waters*, he proposes a formula depending on the sum of the velocity and its square, for the expression of the friction; and deducting a constant coefficient from twelve experiments of Chezy and Dubuat, he obtains a formula equally correct with that of Dubuat, and far more simple.

Mr De Prony has obtained an expression founded on the same theoretical principles that Mr Girard had adopted, but much more perfect and accurate, and agreeing very sufficiently with all those of Mr Dubuat's experiments to which he has applied it. But Mr De Prony's formula, as well as Mr Dubuat's, fails altogether, when we attempt to employ it for the computation of the discharge through very slender tubes, and though his work was printed a year or two earlier than Dr Young's investigations, it would have been impossible for this philosopher to make any use of it in his physiological inquiries, even if it had not been wholly unknown to him, since the resistances which he had occasion to compute were principally such as occurred in tubes considerably less than a thousandth of an inch in diameter.

The most material deviation of the experiments from the theory of Mr Coulomb and Mr De Prony appears to arise from the great comparative increase of that portion of the resistance which varies simply as the velocity, when the tubes become extremely small; and it is upon this circumstance that Dr Young has founded the principal characteristic of his theory of the circulation of the blood; the resistance, notwithstanding the extreme slowness of the motion of the blood through the capillary vessels, being almost entirely confined to those vessels; and in order to comprehend in one formula the whole of Dubuat's experiments, together with those of Gerstner, and his own, on very small pipes, he has found it necessary to introduce, into the determination of the coefficients for expressing the two kinds of resistance, a quantity depending on the diameter of the tube, and capable of being readily computed from it, although by a formula which is founded on empirical evidence only. The method of calculation, however, appears to be equally general and convenient, and it will, therefore, not be superfluous to copy the particulars of the investigation in the words of the author.

Dr Young "found," he observes, "that the friction could not be represented by any single power of the velocity, although it frequently approached," for the same pipe, "to the proportion of that power, of which the exponent is 1,8; but that it appeared to consist of two parts, the one varying simply as the

velocity, the other as its square. The proportion of these parts to each other must, however, be considered as different, in pipes of different diameters, the first part being less perceptible in very large pipes, or in rivers, but becoming greater than the second in very minute tubes, while the second also becomes greater, for each given portion of the internal surface of the pipe, as the diameter is diminished."

"If we express, in the first place, all the measures in French inches, calling the height employed in overcoming the friction f, the velocity in a second v, the diameter of the pipe d, and its length l, we may make $f = a\frac{l}{d}v^2 + 2c\frac{l}{d}v$; for, it is obvious, that the friction must be directly as the length of the pipe; and since the pressure is proportional to the area of the section, and the surface producing the friction to its circumference or diameter, the relative magnitude of the friction, "or the friction for any given portion of the section," must also be inversely as the diameter, or nearly so, as Dubuat has justly observed. We shall then find that a must be $.0000001\left(430 + \frac{75}{d} - \frac{1440}{d+12} - \frac{180}{d+\frac{1}{3}}\right)$, and $c = .0000001\left(\frac{900dd}{dd+1000} + \sqrt{\frac{1}{d}}\cdot\left[1050 + \frac{12}{d} + \frac{.9}{dd}\right]\right)$. Hence it is easy to calculate the velocity for any given pipe or river, and with any given head of water. For the height required for producing the velocity, independently of friction, is, according to Dubuat, $\frac{vv}{478}$, or rather, as it appears from almost all the experiments which I have compared, $\frac{vv}{550}$; and the whole height h is therefore equal to $f + \frac{vv}{550}$, or $h = \left(\frac{al}{d} + \frac{1}{550}\right)v^2 + \frac{2cl}{d}v$; and making $b = \frac{1}{al:d + .00182}$, and $e = \frac{bcl}{d}$, $v^2 + 2ev = bh$, whence $v = \sqrt{(bh + e^2)} - e$. In order to adapt this formula to the case of rivers, we must make l infinite; then b becomes $\frac{d}{al}$, and $bh = \frac{d}{a}\cdot\frac{h}{l} = \frac{ds}{a}$, s being the sine of the inclination, and d four times the hydraulic mean depth; and since e is here $= \frac{c}{a}$, $v = \frac{\sqrt{(ads + cc)} - c}{a}$: and in most rivers, v becomes nearly $\sqrt{(20000ds)}$."

"In order to show the agreement of these formulæ with the result of observation, I have extracted," says Dr Young, "as indiscriminately and impartially as possible, forty of the experiments made and collected by Dubuat; I have added to these some of Gerstner's, with a few of my own; and I have compared the results of these experiments with Dubuat's calculations, and with my own formulæ, in separate columns." "It appears from this comparison, that in the forty experiments, extracted from the collection, which served as a basis for Dubuat's calculations, the mean error of his formula is $\frac{1}{24}$ of the whole velocity, and that of mine $\frac{1}{25}$ only; but if we omit the four experiments, in which the superficial velocity only of a river was observed, and in which I have calculated the mean velocity by Dubuat's rules, the mean error of the remaining 36 is $\frac{1}{[illegible]}$, according to my mode of calculation, and $\frac{1}{37}$, according to Mr Dubuat's; so that" "the accuracy of the two formulæ may be considered as precisely equal with respect to these" forty "experiments. In" "six experiments which Dubuat has wholly rejected," "without any very sufficient reason," "the mean error of his formula is about $\frac{1}{24}$, and that of mine $\frac{1}{45}$. In fifteen of Gerstner's experiments, the mean error of Dubuat's rule is $\frac{1}{[illegible]}$, that of mine $\frac{1}{4}$; and, in the three experiments which I made with very fine tubes, the error of my own rules is $\frac{1}{15}$ of the whole, while in such cases Dubuat's formulæ completely fail." "It would be useless to seek for a much greater degree of accuracy, unless it were probable that the errors of the experiments themselves were less than those of the calculations; but if a sufficient number of extremely accurate and frequently repeated experiments could be obtained, it would be very possible to adopt my formulæ still more correctly to their results.

"If any person should be desirous of making use of Dubuat's formula, it would still be a great convenience to begin by determining v according to this method; then, taking $b = \frac{l}{h - vv:478}$, or rather, as Langsdorf makes it, $b = \frac{l}{h - vv:482}$, to proceed in calculating v' again "by the formula $v = 148.5(\sqrt{d} - .2)\cdot\left(\frac{1}{\sqrt{b} - \mathrm{HL}\sqrt{(b+1.6)}} - .001\right)$, since this determination of b will, in general, be far more accurate than the simple expression $b = \frac{l+45d}{h}$, and the continued repetition of the calculation, with approximate values of v, may thus be avoided. Sometimes, indeed, the values of v, found by this repetition, will constitute a diverging instead of a converging series; and in such cases, we can only employ a conjectural value of v, intermediate between the two preceding ones."

"Having sufficiently examined the accuracy of my formula, I shall now reduce it into English inches, and shall add a table of the coefficients, for assisting the calculation. In this case, a becomes .0000001 $\left(413+\frac{75}{d}-\frac{1440}{d+12.8}-\frac{180}{d+.355}\right)$, $c=.0000001\left(\frac{900dd}{dd+1136}+\frac{1}{\surd d}\left(1085+\frac{13.21}{d}+\frac{1.0563}{dd}\right)\right)$, and $b=\frac{1}{al:d+.00171}$, e being $\frac{bcl}{d}$, and $v=\surd(bh+e^2)-e$, or, for a river, "$=\surd\left(\frac{ds}{a}+\frac{cc}{aa}\right)-\frac{c}{a}$, as before; and in either case the superficial velocity of a river may be found, very nearly, by adding to mean velocity v its square root, and the velocity at the bottom by subtracting it.

Table of Coefficients, for English Inches.

d	a $.1^7\times$	c $.1^7\times$	d	a $.1^7\times$	c $.1^7\times$	d	a $.1^7\times$	c $.1^7\times$	d	a $.1^7\times$	c $.1^7\times$
∞	413	900	40	388	698	4	306	556	.4	254	1779
500	410	944	30	377	597	3	292	635	$\frac{1}{3}$	268	1963
400	409	918	25	371	526	2.5	284	694	.3	280	2082
300	406	951	20	364	482	2	277	774	$\frac{1}{4}$	305	2307
200	404	951	15	354	430	1.5	266	894	.2	354	2631
100	399	918	10	339	413	1	251	1099	$\frac{1}{6}$	409	2943
90	398	903	9	336	421	.9	248	1161	.5	447	3150
80	396	885	8	331	433	.8	245	1234	$\frac{1}{7}$	466	3251
70	393	860	7	327	449	.7	243	1332	$\frac{1}{8}$	528	3558
60	391	825	6	322	471	.6	243	1433	$\frac{1}{9}$	599	3866
50	389	772	5	312	507	.5	245	1578	.1	657	4183

"Coulomb's experiments on the friction of fluids, made by means of the torsion of wires, give about .00014 for the value of c, which agrees as nearly with this table, as any constant number could be expected to do. I have, however, reason to think, from some experiments communicated to me by Mr Robertson Buchanan, that the value of a, for pipes about half an inch in diameter, is somewhat too small; my mode of calculation, as well as Dubuat's, giving too great a velocity in such cases."

It must, indeed, be confessed that, notwithstanding the convenience of this theory for calculation, with the assistance of the tables of coefficients, their determination from the diameters of the pipes is somewhat too complicated either for elegance or for probability, if considered as representing the law of nature. The formula of Prony, though it fails for small pipes, and would, therefore, have been useless for Dr Young's purpose, has the advantage of great simplicity, and even of superior accuracy, within certain limits of the magnitude of the pipes, although it seems to be indebted for this accuracy to accidental causes only.

If we take Dr Young's equation $v=\frac{\surd(ads+cc)-c}{a}$, or $v=\surd\left(\frac{ds}{a}+\frac{cc}{aa}\right)-\frac{c}{a}$, and assume for a the constant mean value .0000377, and for c .00003466, we shall have $v=\surd(26520ds+.845)-.919$, which is equivalent to Prony's formula reduced to French inches. For pipes Mr De Prony merely substitutes $\frac{h}{l}$ for s, neglecting entirely the height $\frac{vv}{550}$ due to the velocity. He also gives a still simpler approximation for common purposes, $v=\surd\left(26513\frac{dh}{l}\right)$, or $\surd(26513\,ds)$, which differs very little from Dr Young's rule published in his *Lectures*, that "the velocity is a mean proportional between the hydraulic mean depth and the fall in 2800 yards;" for this, in French measures, would be $\surd(27000\,ds)$. It is obvious, however, that in many cases these formulas must require considerable modification, since, when the velocity is great, the height due to it may become considerable, and since the friction in small pipes is certainly increased beyond its mean value: nor can these opposite causes of error be expected always to compensate each other even in pipes of moderate dimensions.

If we had a greater number of very accurate experiments, we might construct a sufficiently complete table of the values of a and c from their results alone, without any general formulas. Thus, taking $f=h-\frac{vv}{550}$, we readily obtain the equation, $a=\left(\frac{f}{v}\cdot\frac{d}{l}-\frac{f'}{v'}\frac{d'}{l'}\right)\cdot\frac{1}{v-v'}$, in which f and f', v and v', are the corresponding values of f and v for the same pipe with different pressures, or for two pipes so nearly alike in diameter, that the coefficients may be considered as the same for both; and then $2c=\frac{f}{v}\cdot\frac{d}{l}-av$: or for a river, $a=\frac{ds}{v}-\frac{d's'}{v'}$, and $2c=\frac{ds}{v}-av$. But the results of twelve double experiments, compared in this manner, afford a very irregular series only; thus:

No.	d	10^7a	10^7c	
1	262.5	681	Negat.	Exp.
2	258.5	387	1453	Dub.
3	5	344	478	
4	2.01	256	1156	
5	1	320	599	
6	1	296	1000	
7	1	214	2420	
8	.242	314	2020	
9	.167	351	2420	
10	.125	568	2870	
11	.2	156	4420	Gerstn.
12	.133	58	4690	Gerstn.
		12)3905	23526	
		325	1960	

It is, therefore, hopeless to attempt to deduce a good formula for the coefficients from these results alone, and we must be satisfied for the present either with Dubuat's formula, or Prony's, or with Dr Young's table. For a single instance of the comparative accuracy of these modes of computation, we may take an example from Mr Jardine's observation of the pipe supplying Edinburgh with water, as published by Dr Brewster. Here d was 4.5, h 612, l 179160, and v 20.52 English inches. We have, therefore,

$$a = .0000309,\ c = .0000532\frac{l}{d} = 39813,\ al:d = 1.22023,$$

$$\frac{1}{b} = 1.222,\ e = 1.733, \text{ and } v = \surd(500.8+3) - 1.73 =$$

20.71, exceeding the observation by .19. Dubuat's formula falls short by .13 only, Prony's table by .96. It must, however, be observed, that in so great an extent of pipe, it is scarcely possible that some partial obstruction should not always occur, which must make the actual velocity somewhat less than the theory ought to give, so that the slight difference between the formulæ of Dubuat and Dr Young can scarcely be said to be in favour of the former.

It is, however, remarkable that in this instance, as well as in some others, a single formula, which Dr Young had published in an abstract of Professor Eytelwein's book, is still more accurate than the more refined calculations. This formula is $v = 50\surd\left(\frac{dh}{l+50d}\right)$, the measures being expressed in English feet; thus, in the example here computed, this formula gives us $v = 20.56$ inches. It is equivalent, for inches, to $v = \surd\left(\frac{30000\,dh}{l+50d}\right) = \surd\left(\frac{30000h}{l:d+50}\right) = \surd\left(\frac{h}{.0000333l:d+.001}\right)$, which implies that c may be neglected in such pipes at least, and a may be taken $.1^7 \times 333$, which does not greatly differ from the tabular value for the given diameter. It has happened, from a combination of accidental circumstances, that Dubuat has been deprived of a considerable portion of his just merits, in favour of Mr Eytelwein, without any kind of voluntary plagiarism on the part of this very respectable Professor. The author of the English abstract of his work was acquainted with Dubuat's book, only from having read the extracts, copied from it by Professor Robison, in his contributions to the *Encyclopædia Britannica*, and he was hence led into the mistake of supposing Professor Eytelwein the author of many improvements, which he had no more idea of claiming than he could have had of several modifications introduced into the "*Summary of Hydraulics*," chiefly extracted from his book, which appeared in the *Journal of the Royal Institution*, and which have been quoted as Eytelwein's.

The resistance occasioned by the flexure of a pipe, must not be neglected when any great accuracy is required in the determination of the water conveyed by it. Dr Young has pointed out the inadequacy of Dubuat's method of calculating this resistance, and his remarks may again be copied in his own words.

"Mr Dubuat," he continues, "has made some experiments on the effect of the flexure of a pipe in retarding the motion of the water flowing through it; but they do not appear to be by any means sufficient to authorise the conclusions which he has drawn from them. He directs the squares of the sines of the angles of flexure to be collected into one sum, which, being multiplied by a certain constant coefficient, and by the square of the velocity, is to show the height required for overcoming the resistance. It is, however, easy to see that such a rule must be fundamentally erroneous, and its coincidence with some experiments merely accidental, since the results afforded by it must vary according to the method of stating the problem, which is entirely arbitrary. Thus it depended only on Mr. Dubuat to consider the arc of a pipe bent to an angle of 144° as consisting of a single flexure, as composed of two flexures of 72° each, or of a much greater number of smaller flexures, although the result of the experiment would only agree with the arbitrary division into two parts, which he has adopted. This difficulty is attached to every mode of computing the effect, either from the squares of the sines, or from the sines themselves; and the only way of avoiding it is to attend merely to the angle of flexure as expressed in degrees. It is natural to suppose that the effect of the curvature must increase, as the curvature itself increases, and that the retardation must be inversely proportional to the radius of curvature, or very nearly so; and this supposition is sufficiently confirmed by the experiments, which Mr Dubuat has employed in support of a theory so different. It might be expected that an equal curvature would create a greater resistance in a larger pipe than in a smaller, since the inequality in the motions of the different parts of the fluid is greater; but this circumstance does not seem to have influenced the results of the experiments made with pipes of an inch and of two inches diameter: there must also be some deviation from the general law, in cases of very small pipes having a great "radius of" curvature; but this deviation cannot be determined without further experiments. Of the twenty-five which Dubuat has made, he has rejected ten

as irregular, because they do not agree with his theory; indeed, four of them, which were made with a much shorter pipe than the rest, differ so manifestly from them that they cannot be reconciled; but five others agree sufficiently, as well as all the rest, with the theory which I have here proposed, supposing the resistance to be as the angular flexure, and to increase, besides, almost in the same proportion as the radius of curvature diminishes, but more nearly as that power of the radius of which the index is $\frac{7}{8}$. Thus if p be the number of degrees subtended at the centre of flexure, and q the radius of curvature of the axis of the pipe in French inches, we shall have $r = \frac{pv^2}{200000q}$ nearly, or more accurately $r = \frac{.0000045pv^2q^{\frac{1}{8}}}{q}$. These calculations are compared with the whole of Dubuat's experiments in the following table. The mean error of his formula in fifteen experiments, and of mine in twenty, is $\frac{1}{25}$ of the whole."

The methods of computation here proposed may be illustrated by a practical example, which is of a nature very likely to be of frequent occurrence. *Let the length of a pipe* l *be 1000 feet, let it have five flexures, each equal in extent to a right angle with a radius of curvature* q *of six inches; let the height of the head of water* h *be ten feet, and let the quantity of water to be delivered be one ale hogshead, or fifty-four gallons in a minute; required the diameter of the pipe* d.

Neglecting the slight difference between French and English inches, with respect to the effect of curvature, we have $p = 450$, $q^{\frac{1}{8}-1} = .2085$, and $r = .0004222v^2$, which must be added to $\frac{al}{d}$, the coefficient of v^2 in the general formula. Now, since an ale gallon fills 10 yards of inch pipe, the velocity discharging a gallon in a minute by such a pipe would be 6 inches, and for 54 gallons, 324 inches; consequently, for any other pipe, of the diameter and the velocity discharging a hogshead in a minute must be $\frac{34}{dd}$. Hence we might obtain, by means of the formulæ expressing the coefficients, a regular equation in terms of d and its powers, but it would be of too high an order to be at all manageable; the very general method, termed by arithmeticians the rule of double position, affords much the readiest solution. Thus, supposing $d=4$, we have $a = .0000306$ and $c = .0000556$, and since $\frac{l}{d} = 3000$, the coefficient $al : d$ becomes .0918, to which if we add .00171, according to the formula, and $r = .0004222$, we have $b = \frac{1}{.0939322}$, and $e = \frac{bcl}{d} = \frac{.1668}{.093932} = 1.776$, whence $= (bh+e^2) - e = 8.70$; but $\frac{324}{16} = 20.25$; therefore, the pipe is too small, and we must try five inches, a being .0000312, and $c = .0000507$; hence $al\ d = .07488$, and $b = \frac{1}{.0770122}$, $e = \frac{.1468}{.0770122} = 1.901$ and $v = 9.65$, while $\frac{324}{25} = 1296$. Here the differences of the values of v are $+ 11.55$ and $+ 3.31$, their difference 8.24 answering to a difference of an inch in the diameters. We must, therefore, add $\frac{3.31}{8.24} = .402$, and the diameter required will be 5.40 inches; and if we wish for very great accuracy, we may repeat the calculations once more with this value of d.

The remainder of the investigations contained in Dr Young's two papers are more immediately connected with Physiology than with Hydraulics; and the interesting experiments of Girard, published in the *Memoirs of the Academy of Sciences* for 1818, relate almost entirely to the effects of temperature on the mechanical properties of bodies possessed of different chemical characters.

(R. T.)

I

Jains.

JAINS (called by some JOINUS), a sect or rather race of Hindoos, found in considerable numbers in different parts of India, particularly in the southern peninsula. They form a class of dissenters from the established faith of Brahminism, so generally considered throughout India as alone founded on an orthodox basis. They deny altogether the authority of the Vedas, regarded by the genuine Hindoo as the holiest of books. They either disown, or sink into a subordinate station, all the grand objects of Hindoo veneration. In their hypothesis concerning the origin of the world, they have adopted opinions which seem to partake of the character of atheism. They do not, like the followers of the Vedas, acknowledge any spiritual and eternal Being, from whom the universe derived its origin. The material world, as well as the minds of all men and animals, are held by them to be eternal. They refuse to acknowledge any thing which is not, or has not been, the object of the senses. Upon this principle they deny the existence of any beings superior to man, and admit no objects of worship except men who have raised themselves by their merits to the rank of divinities. As, however, they set no bounds to the perfection which the human soul may arrive at, their most eminent saints and pontiffs (among whom they particularly celebrate Gomat Iswara Swami) partake almost the attributes of Supreme Divinity. To this station, however, they are exalted, not in consequence of a virtuous life, or of benefits rendered to mankind, but of those excesses of absurd and extravagant penance to which, throughout all India, such sovereign merit is attached. They have three ranks of ascetics, whom they call *Yatis*. The first, called *Anuvrata*, can be attained only by him who forsakes his family, entirely cuts off his hair, holds always in his hand a bundle of peacock's feathers and an earthen pot, and wears only clothes of a tawny colour. The second rank, *Mahavrata*, requires that all dress should be abandoned, except a mere rag to cover nakedness, and that the hair, instead of being shaven off, should be pulled out by the roots. He who aspires still higher, and seeks to attain the third degree, or *Nirvana*, throws aside even rags, and remains entirely naked; he eats nothing but rice, and that only once in two days. The name is nearly synonymous with that of Deity, and he is held in nearly equal veneration with the priests and rajas, whose images are worshipped in the temples. At Billicull, or Belligola, the residence of their high priest, they have a gigantic image of Gomat Iswara Swami, the foot of which is nine feet in length, so that the height of the entire statue cannot be less than fifty-four feet; and there is a similar one at Kurcul, near Mangalore. This worship of gigantic images is common to them with the followers of Boodha, whom they also closely resemble in their theological tenets; nay, Samana and Gaudma, the main objects of Boodh veneration, are enumerated by the Jains among the earliest and most venerated of their priests. On the other hand, they differ from them entirely in being divided into four casts, distinguished from each other by the same privileges and manners as among other Hindoos. The Jains observe also similar penances, carrying them only to a greater extreme. They are also scrupulous to a still greater degree as to causing the death of any living thing, even the minutest insect. The strictest Jains, to guard against this danger, do not eat after sunset; they have always a small broom to sweep the ground before them, and never drink water unless strained through a cloth. The orthodox Hindoos have ceremonies by which any involuntary offence of this kind may be expiated; but the Jains, not allowing the efficacy of these, have no means of relieving their soul from the burden of such a trespass. Like the other Hindoos, they consider it unlawful for the widow to marry again, but discourage the barbarous practice of sacrificing herself on the body of the husband. On the whole, it would appear that while their doctrines and belief closely coincide with those of the Boodhists, their civil and social life is discriminated only by minute shades from that of the Hindoos. They have a system of their own with regard to history, chronology, and physics, of which we need only observe, that its tenets are still more extravagant and absurd than those contained in the orthodox pages of the Vedas and Puranas.

Jains
||
Jauts.

See *Asiatic Annual Register*, Vol. IX.—Dubois *on the Manners of the People of India*, Lond. 1817.—Ward *on the History, Literature, and Religion of the Hindoos*. Lond. 1817. (B.)

JAUTS, a people of Hindostan, who have at different times made some figure in its annals. The first historical mention of them occurs at the beginning of the eleventh century, on the invasion of India by Mahmoud the Gaznevide. That conqueror found them established on the eastern bank of the Indus, prepared to oppose his passage. For this purpose they had mustered a large fleet of boats, to the number, according to some accounts, of eight thousand. They were completely defeated, however, and driven into the mountainous districts in the interior of India.

From this time the Jauts remained in obscurity, till the reign of Aurengzebe. Churamana, a Jaut of some distinction, collected then some troops of banditti, with whom he began to commit depredations on travellers. Popular and enterprising, he gradually rose from a captain of robbers to be a powerful chieftain, and availing himself of Aurengzebe's absence in the Decan, became the terror of the country round. He had even the audacity, on one occasion, to plunder the rear of that monarch's army; and, when pursued, took refuge among the

mountains of Narwar, where he eluded all attempts to extirpate his force. Under the growing imbecility of Aurengzebe's successors, the Jauts continually extended their power, till at length, during the weak reign of Mahommed Shaw, and under their enterprising head, Sooraje Mull, it rose to its utmost height. That chief wrested continually new concessions from the weak emperor, till he was able almost to dictate the counsels of the Mogul court. A reverse, however, took place on the invasion of northern India by Ahmed Shaw, the sovereign of Caubul. Sooraje Mull, having opposed that invader, saw his territory overrun, and was obliged to seek aid from the Mahratta power. When the Mahrattas, however, invaded Delhi, the Jaut chief went over to Ahmed Shaw, and offered to atone for former hostility by his services on that critical occasion. The battle of Panniput followed, in which the Mahrattas were totally routed, and their power for the time entirely broken. Ahmed Shaw rewarded the services rendered by his new ally in this hour of need, by the important cession of Agra and its district. Sooraje Mull, and his son Jowalier Sing, made repeated attempts to obtain possession of Delhi, but were always baffled by untoward circumstances. Jowalier Sing was assassinated by an impostor, who had undertaken to initiate him in the secret of the philosopher's stone. He left his son an infant;—a circumstance which, affording an open field to the dissensions of the chiefs, weakened the Jaut power, and rendered it unable to contend with the other fierce competitors for the spoils of the Mogul. In their contests, particularly with Nujeph Khan, they were gradually stripped of all their possessions, and at length reduced to the fortress of Bhurtpoor, with a small surrounding district. When the British power became predominant in this part of India, Runjeet Sing, Rajah of the Jauts, sought security by concluding a treaty with Lord Lake, by which, on engaging to assist Britain against all enemies, he not only retained the internal government of his territories, but was even exempted from paying any tribute. Yet, in 1805, after the defeat of Holkar, he received that chief, with his discomfited army, into Bhurtpoor. The place sustained a most desperate siege, and cost the British army an immense number of lives. At length the Rajah, despairing of effectual resistance, agreed to compel Holkar to quit the place, and to give it up to the British, on condition of retaining the government of his territories, and the fortress of Deeg. He was obliged, however, to pay twenty lacks of rupees, and to give ample security for a more faithful observance of this treaty than of the former.

See *Asiatic Annual Register* for 1802.—Mill's *History of British India*, 3 vols. 4to. Lond. 1818 (B.)

JAVA. The *Encyclopædia* contains a short description of this extensive and important island. Since that article was written, a large mass of valuable information has been communicated to the public in the *History of Java*, by Sir Stamford Raffles, who, in the capacity of Governor of the Island, enjoyed ample means of gratifying his liberal spirit of inquiry; and in the *History of the Indian Archipelago*, by Mr Crawfurd, late Resident at the Court of the Sultan of Java;—a work equally distinguished by accurate observation and philosophical reflection.

Manners of the Javanese. Of all the islands which compose the great Indian Archipelago, Java, though not the most extensive, is the most fertile, the most populous, and the most improved. Among the two races of people who inhabit the Oriental Islands, distinguished into the brown coloured race, and the Papuas, or Oriental negroes, the natives of Java belong to the former. They are under the middle size, the standard for men being five feet two inches, and for women four feet eleven inches. Their complexion is a yellowish brown, generally without any tincture of red. Of this colour they admire the fair specimens, and their standard beauty is a virgin gold; but they consider the European white as a sickly tint. They have a round face, little black eyes, a small nose, and a large mouth, with thick lips. On the head, beard, and other parts of the body, there is a remarkable deficiency of hair. Compared with the Europeans and Southern Asiatics, they are considered by Mr Crawfurd as an ill-looking race; but the opinion of Sir S. Raffles is, in this respect, more favourable. Their constitution is healthy, and they seem to attain a longevity equal to that of Europeans. Early marriages are as universal as among other Asiatics, a man being scarcely ever known single at twenty-five, while an unmarried female at eighteen is considered an old maid. The lot of the female sex differs considerably from what it usually is among Asiatics. They are by no means immured with the same jealousy; British gentlemen have even been admitted to visit the harams of the sultans and chiefs, where they were received by the ladies with all the dignified propriety of persons accustomed to mix in general society. To women, the commercial and pecuniary affairs of the family are almost wholly entrusted. Of these privileges and advantages, they are said not always to make the very best use. The right of divorce, with which they are indulged equally with the other sex, is carried by them beyond all excusable limits. It is very common for a woman, before the age of thirty, to have divorced three or four husbands; and Mr Crawfurd had one pointed out to him who was living with her twelfth. No difficulty occurs in regard to the disposal of the children, who, in Java, are never viewed in the light of a burden. Besides being easily supported, they are usually few in number, a circumstance ascribed to the hard labour which the mothers undergo, and the consequent frequency of abortion. Besides the management of the household, they weave all the cloths worn in the family, and perform various other offices, which in Europe devolve on the other sex. Polygamy is permitted by law, but it is known only among the great; and, even with them, the first wife alone is of their own rank, and mistress of the family; the others occupy a place decidedly inferior. The natives of Java were drawn by their Dutch masters in very dark colours: but the English residents, after careful observation, have described them much more favourably. They are generous, warm-hearted, and susceptible of strong attachments. Their affections of kindred are peculiarly forcible; so that, even in civil

Java.

contests, those fraternal enmities, so conspicuous in other Asiatic states, are scarcely ever observable. The English, who placed confidence in them, found them honest in the intercourse of common life; and they share only in a slight degree those habits of piracy for which the Malay tribes are so notorious. In society they are uncommonly good humoured, courteous, and polite, and scarcely ever seen in a passion, unless on those occasions when they are hurried to the last extreme of violence. These unhappily too often occur, under the impulse of that violent jealousy and revenge, which form their ruling passions. The disregard of human life seems to proceed to an excess among them, scarcely known in any other quarter of the globe. It is stated that, in any part of Java, an assassin may be hired for the moderate sum of fifteen or twenty shillings; but, in general, the injured party conceives it more honourable to decline this cheap mode of redress, and to seek vengeance with his own hand. Some, driven to the extreme of desperation, run furiously into the streets, and kill indiscriminately all whom they meet, till they are themselves overpowered and cut down. This dreadful atrocity, which, by a corruption of the native term, is called "running a muck," is said, however, to prevail, not among the native Javanese, but among the other Malay tribes, resident in the capital.

Religion.

In the ancient religion of the Javanese, which was undoubtedly derived from Hindostan, Siwa, with his family, and Buddha, were the chief objects of adoration. Their temples appear, from the late inquiries of our countrymen, to have rivalled the splendour of those erected in the native seats of their religion. In the course of the fifteenth century, the whole island of Java was, by Arab traders and settlers, converted to Mahomedanism. This faith, however, which is generally observed with so much strictness, is professed here in a very loose and imperfect manner. It need only be observed, that wine and spirits are not only used without scruple on ordinary occasions, but are even sometimes produced at religious festivals. An extreme indifference prevails as to all its outward observances. In return, superstitious credulity prevails to a degree almost unparallelled. A belief in sorcery is universal. If a person write the name of another on a scull, bone, or leg, and suspend it from a tree on haunted ground, where two roads meet, the laws doom to death, himself, his friends, his children, and his children's children. Availing themselves of this credulity, various persons usually start up, in troubled times, as saints, prophets, or as the descendants of one of the ancient kings of Java, and attract a multitude of followers. Christianity has not obtained any footing in Java; and Mr Crawfurd doubts if it ever will, till the conduct of its Indian professors becomes more conformable to its precepts.

Language.

The Javanese language is the most copious and improved of any used in the Indian islands. It has Sanscrit for its basis, but with considerable variations. In the beauty of its written characters, it is not surpassed by any of the languages of Asia. It is distinguished by its vast copiousness as to particular, and barrenness as to general terms. Thus there are five names for a dog, and seven for a horse, but no general word for an animal. The abstract terms, nature, space, and others of that kind, are entirely wanting. All their literature, as is usual among rude nations, is metrical, and may be divided into lyrical compositions or songs; romances founded on Hindu legends; romances founded on modern story; histories of modern transactions; legal and ethical tracts, chiefly in prose. Of these compositions, the songs, in which feeling and passion are simply expressed, appear to be the most pleasing. The romances consist chiefly of abridged translations of the Mahabarat and Ramayana, from the Hindoo original into a now dead Javanese language, called the *Kawi*. These versions, being free from the endless prolixity of the originals, may be read with greater pleasure. Java had no history previous to the Mahomedan invasion; and even now, its annals consist merely of metrical legends, which being written under the eye of the prince whose deeds they relate, cannot be suspected of very strict impartiality. Besides the rudeness of these compositions, there is an absence of that energy, ardour, and sublimity, which have often characterized the poetry of far ruder nations. This seems justly ascribed to the despotic form of the government, which represses all the nobler sentiments natural to independent man, when individual character is permitted to unfold itself.

Government.

The government of Java is more absolute than that of any other part of the Archipelago, and differs little in this respect from the great monarchies of Asia. There is no rank but what emanates from the sovereign; and no bounds are set to the marks of respect shown by inferiors to the higher classes. No individual, of whatever rank, can stand in the presence of a superior, not even the heir-apparent in that of the sovereign. Whenever a chief appears in public, all his inferiors must throw themselves into the posture called *dodok*, which may be rendered by the English term "*squatting*;" in which they remain till he disappears. Sir S. Raffles describes himself as much annoyed at seeing, in one of his progresses, the whole population of the country quitting their work, and remaining fixed in this uneasy posture so long as he remained in sight. They have a language, or at least a modification of the common language, which must be used by the inferior, in addressing those of higher rank. The revenue of the sovereign, as usual in Asiatic despotisms, arises from the rent of all the cultivated lands in the country, levied in kind, and in the enormous proportion of one-half of the entire produce. This, however, by the allowance of one-sixth for reaping, is reduced to about two-fifths. It is paid, not into the treasury, but by the king assigning to each of his officers and servants a certain number of cultivators, whose rents he is to receive. The Javan farmer is supposed, on the whole, to be more mildly treated than the Hindoo.

Soil and Produce.

Java is the most fertile of the eastern islands. To this, its lofty mountains and its extensive plains equally contribute. The copious streams, descending from the higher regions, not only supply the requisite moisture, but cover the vallies with deposits of

Java. rich soil. Along the foot of the mountains, this is ten, twelve, or even fifty deep, and of the most excellent quality. Farther from the mountains its fertility becomes less conspicuous; but almost every where throughout the island, the combined influence of heat and moisture is sufficient to raise good crops.

Teak. The most important natural production of Java is the *teak*. This valuable timber is produced abundantly only in Malabar, the Birman empire, and Java. It requires a rich soil to come to perfection, and attains to maturity in eighty or a hundred years. On the plain it acquires a larger growth, but is not so hard as when growing on the mountains, where, however, it scarcely thrives more than three or four thousand feet above the level of the sea. The teak of Java ranks in quality below that of Malabar, but above that of the Birman empire. It might become an extensive object of exportation, the forests of Java being sufficient to afford annually 50,000 beams for ship-building, besides an ample supply for minor objects. The Dutch greatly limited this trade by subjecting it to a rigid monopoly. The English adopted a more liberal system, in consequence of which teak soon found its way into the markets of Bengal; but since the recent cession, the old system has been re-established, and the teak of Java has advanced in price 200 *per cent.*

Rice. Of agricultural products, the most extensive and important is *rice*, the eastern staff of life. The industry and skill of the Javanese, not elsewhere conspicuous, appear to considerable advantage in this culture. The implements are not quite so rude as those used in Indostan; and though there are here none of the extensive tanks constructed in the latter country, the brooks and rivers are advantageously employed for the purposes of irrigation. The rice of Java is copiously exported to the other Indian islands, to China, and sometimes even to Europe. It is considered inferior to that of Carolina and Bengal. When the former sells for 18s. a cwt., and the latter for 11s. 3d., that of Java sells only for 9s. 9d. This inferior value is not owing to any original defect in the grain, but to the unskilful modes of husking and drying it. Maize grows in great luxuriance, but is considered an inferior grain, though its culture has of late been considerably extended, in consequence of the scarcity of lands fit for rice. A variety of pulses are raised as green crops, in the intervals between those of rice.

Coffee. Coffee, though introduced into Java only in 1723, has been found admirably suited to its climate, and is become one of the most important articles of culture. It is produced of good quality only upon the sides of the mountains, three or four thousand feet above the level of the sea. The introduction of this plant has been of the greater value to the island, since the lands upon which it thrives are unfit for any other important product. Coffee is exported to the amount of twenty-six millions of pounds, about two-sevenths of the produce of the West Indies. The trade is susceptible of a much greater extension. The coffee of Java, in the European market, ranks with that of Bourbon, both being considered superior to West India coffee.

Though the cane be a native of the Indian islands, the art of making *sugar* has been introduced from Europe. The rich soil of Java is perfectly suited to this culture, which is reckoned to be carried on there 125 *per cent.* cheaper than in the British West Indies. The produce of Java consists of clayed sugar, which equals or surpasses in quality any other except the Havannah. Hence has arisen an extraordinary demand, which, in the course of a few years, has raised the produce to six times its former amount. In 1818, it was so high as 27,400,000 lbs. The molasses, combined in the proportion of 62 parts with 35 of rice, and 3 of palm wine, yield the arrack for which Java is famous, though it is now made chiefly for internal consumption. Sugar.

Tobacco, another article unknown previous to European connection, has become a general object of consumption and culture in the Indian islands. Java produces the greatest quantity, sending 5,000,000 lbs. to the rest of the Archipelago, and the Malayan peninsula. It produces, also, a considerable quantity of those birds' nests, the gelatinous substance of which forms the fantastic luxury of the Chinese. The annual export to Canton is reckoned at 27,000 lbs., which bring about L.5, 18s. *per* lb. *Cotton* is grown in great quantity, though of quality inferior even to that of the neighbouring islands, to which, however, its cheapness occasions a considerable exportation. In Europe, the cotton of Java is not esteemed; and the present glutted state of its markets affords little encouragement to any exertions to fit the cotton of Java for them. Tobacco and Cotton.

Java does not produce the valuable metals and minerals in any quantity. A considerable quantity of salt is manufactured on its coasts by the simple process of evaporation in the sun. A good deal of saltpetre is also found, though not nearly in the same abundance as in the continent of India.

Manufacturing industry can scarcely be said to exist in Java. Weaving is exclusively practised by the women, who make coarse cloths of cotton, and sometimes of silk, for the use of their families. The trade of a blacksmith is held in high esteem, and considered almost as a liberal profession; chiefly, it is probable, on account of the value attached to the manufacture of arms. Their small boats and barks are made of various and very convenient shapes; but they fail whenever they attempt to construct vessels of any magnitude. Manufactures.

In giving the list of the products of Java, we have given also the articles which it affords for exportation. Its *imports* are important from the augmentation which they have lately received, and of which they are still susceptible. It appears, by Mr Crawfurd's statement, that there does not exist here the same inveterate prejudice against European manufactures as in India and China. Since the opening of the free trade, the fine cottons of Britain have, from their cheapness, in a great measure superseded those of Indostan. Chintzes are the favourite article, in which the pattern is of much consequence. The taste of the Javanese is for bright colours, red and green in preference to all others, and next to these yellow and brown; while black is unsaleable. The pattern should be small, filling the ground without crowding Commerce.

Java || India.

it. White calicoes and cotton cambrics are also purchased by the natives, to be painted by themselves. Although Java lies under the tropics, its mountainous and maritime situation produce a demand for light woollens. These should be cheap Yorkshire cloths, such as cost at Leeds 5s. to 6s. 6d. *per* yard. Iron, to the extent of 28,000 cwt., and to the value of L.22,500, is annually imported into Java, which is destitute of that important metal. The Swedish is preferred, though British iron has of late been introduced to a considerable extent. Fire-arms and ammunition are most saleable articles, but their export has hitherto been prohibited by European governments. There has been recently a great extension of demand for our glass and earthenware. The tea and silks of China, and the opium of Bengal, form the chief articles of importation into Java from Asiatic countries.

Population. The population of Java, including the small contiguous Island of Madura, was found, by a census taken in 1815, to amount to 4,600,000. Of these, three millions are in the provinces immediately subject to European authority; the rest is subject to the native princes. The principal European capitals, Batavia, Samarang, and Surabaya, contain respectively 60,000, 25,000, and 20,000 inhabitants; the chief native capitals, Surakerta and Yug Yukerta, about 105,000 each. The Chinese, amounting to 94,000, form the most active and industrious part of the population; the manufactures of salt, sugar, and arrack, are solely in their hands. Slavery, in Java, prevails to a much less extent than in the other islands. The slaves do not exceed 30,000; and none of them are native Javans, but obtained by purchase or capture from Celebes or Borneo. The philanthropic measures adopted by Sir Stamford Raffles, with a view to the abolition of the trade, were seconded by the chiefs, and productive, to a considerable extent, of the desired effect.

Recent History. The late changes in the European occupation of Java are of the less importance, as they have ended by all things being replaced in their original state. As Holland, after its annexation to France, became hostile to Britain, the consequence was the reduction, by our naval force, of its most important colonial possessions. On the 4th of August 1811, a British force was landed in Java, and, on the 10th, Batavia was taken by storm. The Dutch general, Janssens, retreated to the eastern extremity of the island, where being pursued and defeated by the British forces, he entered into a capitulation for the general surrender of Java. The British government, in the following year, engaged in a war with the native sovereign, which ended in the cession to us of extensive and important districts. Under the enlightened government of Sir Stamford Raffles, most important improvements were made in the judicial system, the collection of the revenue, and the freedom of trade. A literary society was also instituted, which performed important services in investigating the antiquities and natural history of Java. Meantime, upon the downfall of the French military government, and the restoration of independence to Holland, the faith of former alliances required the restoration of the conquests made from the latter power. This obligation was fulfilled by Britain in its fullest extent. At the close of the year 1816, the Dutch took possession of Java, along with their settlements in Celebes and the Spice Islands.

ILLUMINATI. See the article MASONRY-FREE, in the *Encyclopædia*, sect. 91.

IMPROVISATORI. See the article ITALY in this *Supplement*.

INDIA.

Origin of the East India Company.

INDIA, from the rare and precious commodities with which it was known to abound, and from the general belief of its immense wealth, became, at an early period, the favourite resort of commercial adventurers from Europe. The Portuguese had enjoyed its commerce for nearly a century, when the English offered themselves as competitors for the riches of the east. After several unsuccessful adventures, Sir Francis Drake, in 1577, sailed for India, which he reached by Cape Horn, and returned by the Cape of Good Hope, having touched at several of the rich and populous islands which are scattered in the Indian Ocean, and brought back the most favourable accounts of their commerce, and of the friendly dispositions of the inhabitants. He was followed by several other adventurers, some of them of the highest rank, with whose commercial views were combined schemes of predatory enterprise against the Spanish settlements and trade. The first association for a regular trade was formed in 1599, and a capital of above L.30,000 was subscribed in 101 shares, which varied from L.100 to L.3000. This Company fitted out four ships to India, which set sail from Torbay in 1601, and returned in 1603, having made a handsome profit on the capital employed. From 1603 to 1613 eight other voyages were undertaken to India with similar views, and, with the exception of one in 1607, they were all successful, yielding a profit hardly ever below 100, and, in general, above 200 *per cent*. In 1611, those English fleets, notwithstanding the intrigues of the Portuguese, were favourably received by the Mogul government at Surat, which conceded to them the privilege of establishing factories at Surat, Ahmedabad, Cambaya, and Goga; a duty of 3½ *per cent*. being imposed on their merchandise in lieu of all demands. (Mill's *History of British India*, Vol. I. Chap. iii.)

Joint-Stock Company. It was now resolved to adopt the plan of a joint-stock in place of a regulated Company; and, on these terms, a sum of L.490,000 being subscribed, four different voyages were undertaken, the profit on which amounted to only 87½ *per cent*. The profit on the trade, while each individual acted for him-

India.

self, amounted to 171 *per cent.*—a fact which sufficiently illustrates the superior efficacy of individual prudence over every other principle of management. In 1617-18, a second joint-stock was subscribed to the amount of L.1,600,000; but from the hostility of the Portuguese and Dutch—from the active competition of the latter, in the lucrative trade of the Spice Islands—from the bad management of the Directors at home—and, lastly, from the competition of private adventurers, some of whom had the address to procure the King's licence for a voyage to India, the affairs of the Company fell into great disorder. They petitioned King Charles I. and his council against the new and most alarming grievance of a free trade; but it does not appear that they were reinstated in their exclusive privilege till the reign of the Protector in 1656. A new charter was afterwards received from Charles II., containing the important privilege of making peace or war with the native powers, and of seizing unlicensed persons within their limits, and sending them to England. In 1640, a settlement had been effected at Madras. About the year 1651, owing to the influence of the English surgeons, who had effected some remarkable cures at the Court of Mogul, a licence was obtained, on payment of 3000 rupees, for a free and unlimited trade, with the rich and extensive province of Bengal, and in 1668, the Company received possession of Bombay from Charles II., to whom, on his marriage to the Infanta Catherine, it had been ceded by the court of Portugal. (Mill's *British India*, Chap. iv.)

From this period, the increasing wealth of the nation appears to have supplied the Company more liberally with funds for the Indian trade. In 1668, the value of the exports to India amounted to L.245,000; in 1671, to L.456,000; in 1675, to L.789,000; in 1678, to L.352,000; in 1680, to L.161,700; in 1681, to L.596,000; and, in 1682, to L.740,000. The Company's servants in India, however, involved themselves about this period in hostilities with the native powers, and, in the course of this contest, Arungzebe, the most powerful of all the Mogul sovereigns, was so exasperated by their conduct, that he issued orders for the expulsion of the English from India, and for the destruction of their establishments. The factory at Surat was seized; the island of Bombay was attacked; and the other establishments and factories of the Company were in like manner threatened; and it was only by the most abject submissions that the Company could obtain the restoration of the factories at Surat, and the removal of the enemy from Bombay. So detrimental was this contest to the affairs of the Company, that their equipments continued on a very reduced scale for several years.

Union of the Old and New East India Company.

In the mean time, the accumulation of capital in the country subsequent to the reign of Charles I., joined to the growing ardour of the nation for commercial adventure, had given rise to a general impatience of the Company's exclusive privileges, which was heightened and inflamed by the cruel and arbitrary measures pursued for the suppression of the private trade. Doubts began to be suggested as to the legality of restricting the rights of commerce by royal charter without the sanction of Parliament. Applications were made to the Legislature on this subject, which were favourably received. In these circumstances, a proposition was made for the formation of a new company, which was eagerly adopted; and, in 1693, while both parties were keenly urging their pretensions, the old Company offered to Government a loan of L.700,000, at 4 *per cent.*, for a renewal of their charter, and for the monopoly of the Indian trade secured to them by act of Parliament. They were outbidden by their rivals, who offered L.2,000,000, at 8 *per cent.*, for similar privileges. This latter offer was accepted, and a bill for this purpose was brought into Parliament. The old Company were, at the same time, allowed to trade along with the new, for the space of three years, until 1701, according to a proviso in their charter, that three years' notice should be given them previous to their dissolution. The rivalship of those two companies was the occasion of continual jarring and hostility, both at home and between their agents in India, which proceeded at length to undisguised violence. These disputes were displeasing to the nation at large, because they obstructed a highly beneficial trade, by which great riches, it was generally thought, were brought into the country; and the demand being general for a union of those rival interests, the separate funds of the Company were finally united into one great joint-stock. An indenture tripartite, including the Queen and the two Companies, was signed, to give legal efficacy to this transaction. Considerable differences still remained, which, however, it was agreed to refer to the arbitration of Earl Godolphin, Lord High Treasurer; and, in the mean time, an act of Parliament was passed, ratifying the agreement which had been concluded, and enacting that a loan of L.1,200,000 should, at the same time, be advanced to Government without interest; which, being added to the former L.2,000,000, constituted a loan of L.3,200,000, at an interest of 5 *per cent.* The Company were empowered, by the same act, to borrow to the extent of L.1,500,000 on their common seal. In 1708, at the time of the union of the two Companies, the official value of all the exports to India amounted only to L.60,915; in 1715, it fell to L.36,997. It afterwards increased, and the average value of the exports for twenty years, from 1708, was L.92,288.

First Establishments of the Company.

The domestic trade in India, and more especially the provision of the Company's investment, owing to the general insecurity of the country, required expensive establishments for its support, and a body of experienced servants besides, to collect and to purchase commodities for exportation; an employment which, owing to the poverty and abject state of the natives, and their peculiar customs, involved duties of the most minute and laborious detail. During the decline of the Mogul government, the tranquillity of India was frequently shaken by the contentions of rival chiefs, and the slight security afforded even in the best times to commerce, became in this manner more imperfect. For the reception of goods which it was necessary to collect and store up, that cargoes might always be in readiness for the Company's ships, warehouses were built, which,

with the counting-houses, and other apartments for the agents and business of the place, constituted the factories of the Company. These factories contained a valuable store of property, which, in the disordered state of India, it became necessary to secure from the rapacity both of governments and of individuals. The factories were therefore strongly built and fortified, their inmates were armed and disciplined, and, for better security, regular troops were occasionally maintained in these mercantile garrisons. In these defensive arrangements of the Company, we may discern the rudiments of their future empire.

The business of the Company in India was, at this time, managed by the three independent presidencies of Bombay, Madras, and Calcutta. The Presidency consisted of a governor and council of nine, twelve, or any greater number of members, as should seem expedient, in a majority of which all power was vested. The members of the council were not excluded from other more lucrative offices, which were, in general, shared among them. These offices were chiefly in the gift of the president, and, by means of his influence, the council were, in a great degree, placed under his control. The governor and council exercised the most ample powers over all the servants of the Company, and with regard to all others, they could seize and imprison them, and afterwards send them to England. The powers of martial law were bestowed on them at an early period, for maintaining the discipline of the troops under their orders; and, in 1661, a charter of Charles II. gave them the power of administering civil and criminal justice according to the laws of England.

Rate of Profit.

From the conclusion of the peace of Utrecht, the country rapidly advanced in prosperity and wealth, and the Indian trade partook of this general improvement. In the year 1708, the imports amounted to L.493,257, from which they increased to L.1,059,759 in 1730. The rate of profit in 1708 was 8 *per cent.* on a capital of L.3,163,200, from which it gradually rose till, in 1716, it amounted to 10 *per cent.*, at which rate it continued till 1723, when it was reduced to 8 *per cent.* In India, the policy of acquiring dominion was pursued with perseverance and success. In 1698, the Company had been permitted to purchase the zemindarship of the three towns of Sootanutty, Calcutta, and Govindpore, with their districts; to which was afterwards added, a district, extending ten miles from Calcutta, on each side of the river Hoogly, containing thirty-seven towns. In the year 1732, the annual dividend was reduced from 8 to 7 *per cent.*, at which rate it continued till the year 1744.

Increasing power, and oppressive conduct, of the Company.

A new scene was now about to open in India. The European settlers had hitherto occupied the possessions allotted them by the permission of the native powers, to whom they were subject. But as the troops and military preparations of their different settlements increased, their views gradually became more lofty and independent. In 1744, France and England, from being auxiliaries, became principals in the great European war which was then raging, and the flame was soon communicated to their most distant colonies. In India the two rival powers were quickly involved in hostilities, which scarcely ever ceased, until, by the ascendancy of the English, the French, after various changes of fortune, were, in 1761, driven out of the Carnatic. An account of these events having already been given in the *Encyclopædia*, under the articles Britain and Indostan, the following observations will be chiefly confined to the policy adopted by the mercantile sovereigns of India in the internal administration of their newly acquired dominions; and with this view, it will suffice to observe, that, in Bengal, a plan was formed in 1757, in concert with a domestic faction, at the head of which was Meer Jaffier, a relative of the royal family, for the deposition of the reigning Prince Suraja Dowla, who had already waged war against the British, and was averse to their establishment in the country. This plan was accomplished, partly by arms, and partly by intrigue, and Meer Jaffier was raised to the throne of the deposed sovereign. In accomplishing this revolution, the Company's servants, who had imbibed the most extravagant notions of the wealth of India, took care to bargain for enormous sums of money to themselves. The new sovereign, who succeeded to an exhausted treasury, had recourse to the most severe extortions to satisfy the rapacity of his foreign allies. His subjects became discontented and rebellious; his troops mutined for want of pay, and so dissatisfied were the British with his administration, that they dethroned him, and set up Meer Cossim in his stead. The new ruler of Bengal, aware of the tenure by which he held his precarious power, set in motion all the necessary machinery for extorting money from an impoverished people; and he had so far succeeded, partly by a strict and severe administration of his finances, and partly by the most vigilant economy, in restoring the vigour of the government; when every thing was again involved in confusion by the extravagant pretensions and unbounded rapacity of the Company's servants.

In India the transit of goods from one place to another was, under the native governments, subjected to a tax; and upon all the roads, and navigable rivers, toll-houses were erected, where this tax was paid. These toll-houses were multiplied to the great inconvenience and oppression of the internal trade, and as the duties varied in different places, the traders were frequently oppressed by the arbitrary extortions of the collectors. The East India Company had, at an early period, procured an exemption from these duties, for all articles which they were to export, or had imported; and the servants of the Company, who were allowed to engage in the internal trade of the country, frequently endeavoured to abuse this privilege, by claiming an indiscriminate immunity from taxation for all their own goods, which they had neither imported, nor were to export, but which, with a view to the domestic trade of the country, they were transporting from one place to another. This claim was, however, always vigorously resisted, as ruinous alike to the revenue and to the domestic trader; and the native rulers, while they retained their power, always restrained the Company's servants within their appointed limits. But when, by the dethronement of Suraja Dowla, and the elevation of Meer Jaffier, the English acquired un-

disputed ascendancy in the government, they broke through all the equitable restraints which had been imposed upon them, and not only engaged largely in the interior trade, but claimed, under the Company's passport, an immunity from all internal duties, not merely for articles of export and import, but for their whole commerce; and, from the general dread of the English name, the keepers of the different toll-houses no longer exacted the public dues on the transit of their goods through the country. In some cases where the demand was made and the goods stopt, the toll-keeper was arrested by a party of Sepoys, and carried prisoner to the nearest factories; and he was frequently exposed to even greater severities, being tied up and lashed. The confusion into which the country was thrown by the violence and injustice of these rapacious intruders may be easily imagined. The native merchant, still burdened with the heavy transit duties which were rigorously levied on him, was undersold in every market by the Company's servants, who, in a short time, engrossed the whole commerce of the country. The unhappy natives were subjected to various other oppressions. It was a common practice of the Company's servants to defraud them both in purchase and sale; to force goods from them at a lower, and to compel them to buy their own at a higher rate than the market price. Nor did the ordinary tribunals of the country afford any refuge from their injustice; for a band of foreign adventurers had usurped the sovereign power, which they rendered wholly subservient to their own schemes. *

Meer Cossim, the ruler who had been set up by the Company, was extremely displeased with the conduct of their servants, and he represented, in the strongest terms, to the President and Council, the enormities to which the private trade had given rise. But the majority of the Council were too deeply interested in these enormities to be much moved by this just appeal of the sovereign in favour of his oppressed people. They all participated largely in the profits of the private trade, and they had no disposition, therefore, to part with or to restrict this lucrative abuse. They even refused to pay 9 *per cent.* of transit duties on their goods, though this rate was far inferior to that paid by the native traders, and all that they would agree to was, out of their own liberality and free choice, to pay a duty of 2½ *per cent.* on salt alone. The Nabob, when he heard of the proceedings in Council, and of the injurious treatment of his officers for duly executing his orders, was naturally filled with indignation, and, in these circumstances, he came to the resolution of abolishing all internal duties. There could not possibly have been a more moderate or equitable measure. It gave freedom and equality to all parties; it threw down at once all the restraints to fair and open competition, and gave to the Company's servants the unlimited freedom of trade. This just and liberal policy, however, was far from corresponding with their views, and it excited among them the most violent clamours. They were discontented at losing so fair an opportunity for amassing enormous wealth. Their conduct (as Mr Mill justly observes) furnishes one of "the most remarkable instances on record, of the power of interest to extinguish all sense of justice and even of shame." (*British India*, Vol. II. Chap. v. p. 201.)

The conduct of Meer Cossim was so highly displeasing to the majority of the Council, that they resolved to dethrone him, and he, on the other hand, made preparations for war, which he saw was inevitable. The war ended in his discomfiture and flight, first to the Nabob of Oude, and afterwards to the Rohilla country. Meer Jaffier was chosen by the Company's servants to be the nominal ruler of Bengal, on the well understood condition of subservience to their views. A treaty was concluded, confirming the immunity which they claimed from all internal duties, with the exception of 2½ *per cent.* on the article of salt, while those duties were re-imposed on the goods of all other merchants. Large presents were bargained for, and other payments to a great amount, as compensation for losses alleged to have been sustained by the Company's servants, in the course of their illicit interference in the domestic trade. These sums (which were estimated at first, at ten, soon afterwards mounted up to fifty-three lacks of rupees, equal to about L.596,250) were rigidly exacted, while large payments to the Company were still undischarged;—while the public finances were sinking under the burden of an expensive war, and great sums had been borrowed by the Company from its servants, at an interest of 8 *per cent.*; and while, with all these aids, supplies were wanting both for the war and for the investment; the Company's ships frequently returning, in consequence, half loaded to Europe.

Complete ascendancy of the Company in Bengal.

Meer Jaffier dying in 1765, his son, Jaffier, was chosen by the Company's servants in India to succeed him. From each successive sovereign, it was the custom of the electors to exact not only a large donation, but also an extension of power and privileges, so that the native ruler was at length left in possession of little more than mere nominal authority. It was now resolved by the English that they should take upon themselves the whole charge of defending the country, and that they would only allow the Nabob a few troops for the sake of parade, or for other necessary purposes; while, in regard to the civil government, he was to choose a deputy with the advice of the Governor and Council, on whom the whole internal administration of the country should be devolved. So completely was the government under the control of the English, that the accountants of the revenue could not be appointed without their approbation.

During this important revolution, which gave to the British such entire ascendancy in Bengal, the Directors in Europe were distracted by the contradictory reports of their affairs, transmitted to them from India. Being alarmed by the eagerness of their

* See *Ninth Report of the House of Commons on India Affairs*; also a letter of Meer Cossim, dated Backergunge, May 25, 1762, which states, that the inhabitants who refused to sell to the Company's servants were flogged or confined.

servants to embark in expensive wars—by their unwarrantable and rapacious proceedings in regard to the private trade—and by the general disorder and embarrassment of their affairs, they resolved to appoint Lord Clive to the supreme government of Bengal. They at the same time reprobated, in strong terms, the rapacity and tyranny of their servants. In a letter to the Governor and Council they observe, —"Your deliberations on the inland trade have laid open to us a scene of the most cruel oppression." —"The poor of the country," they continue, "who used always to deal in salt, betel-nut, and tobacco, are now deprived of their daily bread by the trade of the Europeans, whereby no kind of advantage accrues to the Conpany, and the government's revenues are greatly injured." (See Mill's *British India*, Vol. II. p. 216.) The Directors, accordingly, issued the most peremptory instructions for the prohibition of the inland trade of salt, betel-nut, and tobacco, or rather of the monopoly held by the Company's servants, by which the country was so cruelly oppressed. The practice of receiving presents from the native rulers and princes, which had been carried to a great extent, was also prohibited. At a general meeting of Proprietors, however, it was urged, in opposition to those wise and salutary restrictions, that the "servants of the Company in India ought not to be deprived of such precious advantages, which enabled them to revisit their native country with independent fortunes." This reasoning convinced the majority of the Proprietors, and a recommendation was moved, in consequence, to the Directors, to re-consider their resolution in regard to the private trade. *The Governor and Council* were therefore instructed, after consulting with the Nabob, to form a "proper and equitable plan for carrying on the inland trade." (Mill's *British India*, Vol. II. p. 217.) In other words, they were to contrive how they could oppress the country, and yet adhere to the rules of equity. This transaction places in a very strong light the corrupt nature of the Company's government. It was admitted on all hands, that it was by extortion and rapine, *i. e.* by compelling the oppressed inhabitants both to purchase and sell at prices fixed by the Company's servants, that such profits were gained, and that they were enabled to return to Europe with enormous accumulations of ill-gotten wealth. It was, indeed, as we have just seen, acknowledged by the Directors, that the poor of the country were deprived of their daily bread by the trade of their European servants, who monopolized every profitable channel of business; yet, with these facts before them, we find the sovereigns of India delivering over their oppressed subjects to the rapacity of their servants, for the avowed purpose of enriching them with the spoils of the country.

Policy of Lord Clive.

Lord Clive assumed the supreme power in India in May 1765. At this period the servants of the Company, in defiance of the peremptory orders of the Directors, still persisted in all the ruinous practices connected with the inland trade; and, in place of abolishing these, and thus remedying some of those abuses of which he so violently complained, Lord Clive entered into a partnership for the monopoly of salt; of which large quantities were accordingly purchased and sold, for a profit of 45 *per cent.*, divided among three of his own dependants,—his secretary, surgeon, and another friend, for whom he wished, as he expresses it, to realize a fortune. The plan of a more extensive monopoly, including salt, betel-nut, and tobacco, the chief articles of consumption in the country, was afterwards devised, to be carried on exclusively for the benefit of the superior servants of the Company, among whom the profit, after setting apart L.100,000 *per annum* to the Company, was to be divided according to their rank in the service. At the time this corrupt scheme of monopoly was established, the Select Committee were in possession of peremptory orders from the Directors for its abolition; but these orders, under various pretences, they delayed to carry into execution till September 1768.

Increased Dividend.

While the servants of the Company in India were thus eagerly devising the means of enriching themselves, their masters were frequently reduced to great pecuniary wants. But, in the midst of all those pecuniary embarrassments, the most flattering accounts of the Company's affairs were circulated in Europe, and on the subject of Indian opulence there was a general disposition to credulity. The splendid acquisition which the Company had made of the territorial revenues of Bengal, the political events in which they had been involved, and the immense fortunes with which a few individuals had returned to Europe, confirmed the general delusion, and inflamed the impatience of the proprietors of East India stock to participate in the inexhaustible treasures of their new dominions. In pursuance of these views, the dividend on their stock was raised from 6 to 10 *per cent.*; India stock rose to 263 *per cent.* A higher dividend was called for, and it was in vain that the Directors represented the heavy debts of the Company, and the general embarrassment of their affairs. The Proprietors refused to listen to such disagreeable representations, and at a general court they voted a dividend of 12½ *per cent.* for the year 1767. The attention of government being now directed to the Company's affairs, this vote was rescinded by act of Parliament, and the dividend limited to 10 *per cent.*

Parliamentary Regulation of the Company's Affairs.

In the mean time, every day's experience was refuting the fallacious expectations of annual treasures from India. It was represented, that the territorial revenue of the Company would prove an inexhaustible source of wealth; and the Directors and Proprietors, in giving ear to these golden promises, of which their servants had been very liberal, were the dupes of their own credulous avarice. Hitherto, however, promises were all that had ever been received from India. So far from possessing any surplus revenue, the servants were involved in debt for the current expences of their government; they drew largely on the directors, but they remitted little; and the whole of this complicated scheme of trade and sovereignty laboured in consequence under such pecuniary difficulties, that the directors, to avert a public bankruptcy, were compelled to apply to the bank for a loan of L.400,000, and afterwards of L.300,000. In consequence of this state of things, so different from the pleasing fancies of unbounded wealth, with which the proprietors of the Company, and the coun-

try at large, had been amused, great discontent, and a violent clamour was raised against the Company's servants in India, who, by their profusion or corruption, had failed to realize those golden dreams. The affairs of the Company were at length brought under the consideration of Parliament by the minister, who introduced two acts for the regulation of their affairs, a full account of which, and of the discussions which took place in consequence, will be found in the *Encyclopædia*, under the articles BRITAIN and COMPANIES. It may suffice to observe here, that these acts vested the administration of the affairs abroad in a Governor-General, with four councillors, rendering the other presidencies subject to that of Bengal, and establishing a supreme court of judicature at Calcutta, consisting of a chief justice and three other judges.

pany the Government of Bengal and Management of Land Revenue.

Although the ascendancy of the English had for some years been thoroughly established in Bengal, and although they were formally invested in 1765 with the sovereignty of the country, its affairs were still administered in the name of the native prince, and according to the forms and policy of the ancient constitution. Justice was still dispensed by the native courts, and by the Nabob's officers; the revenues still flowed through the same channels into the public exchequer; and all transactions with foreign powers were carried on under the same authority as formerly. But such was the increasing power of the English, that the government, so far as regarded the protection of the people, was dissolved. Neither the Nabob nor his officers dared to offer any opposition to their sovereign will; and the tribunals of justice, far from being a refuge to the oppressed, became subservient to the rapacity of the Gomastahs, or Indian agents, employed by the Company's servants, and were converted by them into most efficacious instruments for oppressing and plundering the people.

The Directors had been long dissatisfied with the proceedings of their servants, and with the produce of the land revenues, which had fallen far short of their expectations, and they now resolved to put an end to the double administration of the Nabob and the Company; and dispensing with the empty name of the former, to take upon themselves, ostensibly as well as really, the entire care and management of the land revenues. But they had no right conception of the important consequences which were involved in this measure; they were not aware, that it was an innovation on long established habits and prejudices, and on the settled policy of the country; that it unsettled the basis of property as well as the administration of civil and criminal justice; and that it was calculated to produce a greater revolution in domestic manners, than if the country had been transferred by conquest from one sovereign to another. In order to explain this point, it will be necessary briefly to describe the state of property and manners which prevailed in India under its native rulers.

Under the Mogul government the public revenue was derived from a general land-tax, and the regular payment of this tribute was the tenure by which property was generally held throughout the empire. The lands were possessed by different descriptions of owners or occupiers, under the titles chiefly of *Zemindars*, *Talookdars*, and *Ryots*. The nature of the Zemindary tenure has been a standing subject of controversy among the Company's servants; some insisting, that under the Mogul despotism, the Emperor was the sole proprietor of the lands, and the Zemindar, a species of steward or factor, appointed by the Government to collect and superintend the land revenues; and, after reserving a suitable portion for his own maintenance, to remit the surplus to the treasury; while others maintain that he was proprietor of the lands, and that he was only bound to the state for a stipulated tax or quit rent. Without entering into this controversy, which is rather abstract and speculative than of any practical consequence, it may be observed, that the Zemindars had lived for centuries in great splendour on the produce of their lands, which had quietly descended under the existing tenure through successive generations; that they had the power to sell, to alienate, or to mortgage; and that so long as they paid the annual tribute to government, they enjoyed secure possession of their estates. Under a despotic government arbitrary ejectments might no doubt occur; but these were rare, and they were universally regarded, both in law and usage, as the illegal outrages of abused power. It is admitted, on all hands, that these rights belonged to the Zemindars, and the only point that still remains in dispute (and it does not appear very material) seems to be, whether, according to the theory of the Mogul constitution, the receipt of the land-tax by the sovereign, or of his alloted share of the produce by the Zemindar, entitled the one or the other to the title of proprietor of the land.

The Zemindars, being bound to the state for the revenue, were necessarily invested with the power of collecting the land-tax from the subordinate landholders and tenants. They united, in this manner, legal authority with the possession of property, while, as judges and magistrates, they administered both civil and criminal justice, and were held responsible for all crimes committed within their respective boundaries. In the criminal court held by the Zemindar, he had the power of inflicting all sorts of penalties, and even capital punishments, on reporting the case, before execution, at Moorshedabad. There were various other descriptions of occupiers or tenants, such as the Talookdars, &c. who had hereditary claims on the produce of the soil; and, while the government looked to the principal landholders for the discharge of its demands, the inferior occupants and tenants were bound, each to his immediate superior, for their several proportions of the stipulated tax. The Ryots were the cultivators of the soil, who claimed the hereditary right of occupancy, which they transmitted to their children, and from which, so long as they paid their demands to the state, they could not be lawfully ejected.

The country was divided into villages or districts, comprising some hundreds or thousands of acres of arable and waste land. The district was divided into a greater or smaller number of shares, according to circumstances, and was either cultivated by the joint labour of the whole inhabitants, or each individual was allotted a separate share for his own maintenance. In the one case, the whole population were bound, jointly and severally, for the common rent, while, in the other, each individual paid his separate

share. There were various distinctions of rights among the inhabitants, some of occupancy, some of ownership, of which exact accounts were kept in the public register of the village, as well as by the parties interested.* Every village had also its establishment of public officers and tradesmen. These consisted of the *Potail*, or head inhabitant, whose business it was to superintend the affairs of the village, to settle disputes among the inhabitants, to attend to the police, and to the collection of the public tax; the *Curnum*, to whom it belonged to keep an account of the cultivation and produce of the land—to register the proprietors of the village, and to attest all deeds of sale, transfer, or assignment; the *Boundaryman*, who preserves the limits of the village, or gives evidence of them, in case of dispute; the Priest, the Schoolmaster, the Astrologer; the Smith, the Carpenter, the Potter, the Washerwoman, the Barber, the Cowkeeper, the Doctor, the Dancing-Girl, the Musician, the Poet, who were each rewarded for their labours out of the produce of the village lands. The amount of their shares on the gross produce is estimated at 5½ *per cent.* The collectors were allowed 10 *per cent.*, and the remaining proportion of the crop was divided between the sovereign and the cultivator.

It was not the policy of the Mahometan conquerors, when they invaded India, to innovate materially on the management of the land-revenues, or even to oppress the cultivators by heavy impositions. It was in 1573, during the reign of the Emperor Akbar, that they completed the conquest of the country; and a general rent-roll was at that time formed for all Hindostan, by Rajah Torrel Mull, minister of finance to the emperor, as well as a scheme of division fixing the separate proportions of districts and villages. According to this plan, a settlement was concluded, by which the amount of the tax was fixed at 1 crore, 49 lacks, 61,482 rupees, or nearly L.1,683,166.† This assessment does not appear to have been increased by subsequent monarchs, since its amount, according to the authenticated rent-roll of the Mogul treasury, was, in 1728, L.1,425,000; which is only a variation of L.75,000 from its original standard, in the course of two centuries. Under the Mogul government, however, the inferior occupants and cultivators of the land possessed no adequate security for the possession of their rights; and though, during the vigour of the monarchy, the Zemindars might be restrained by the dread of punishment, or by their regard to laws and immemorial usages, from gross oppression, yet many abuses afterwards took place, under which the share of the crop left to the Ryots was reduced to a bare subsistence.

In the reign of Aliverdi Cawn, who succeeded to the throne in 1741, the land-tax imposed by Akbar was augmented by various arbitrary assessments. To the original ground rent other taxes were added, some permanent, and others occasional. These consisted of duties on the transit of goods through the country, of taxes on shops and manufactures, and of fines and exactions of various sorts; and the Zemindar, who was bound to the state for the revenue, was empowered in proportion to those augmented demands to increase the contribution of his tenants. In the reign of Meer Cossim, who was set up by the Company's servants in 1761, these oppressions were carried to a still greater height. He was raised to the sovereignty on the well understood condition of subservience to the rapacity of the English; he had engaged to pay them large sums on his elevation to the throne, and it was essential to the fulfilment of his iniquitous bargain that he should plunder his subjects. His government is accordingly described as being in the highest degree illegal and oppressive. In place of adhering to the assessment fixed by the ancient policy of the empire, he instructed his agents to ascertain, by exact survey, the produce of the land, and he claimed for the treasury the whole surplus which remained, after allowing a bare maintenance to the cultivators.

After the dethronement of this prince, the country was by no means improved under the growing ascendancy of the English. The state of society which prevailed in Hindostan arose from the mixed operation of a peculiar system of laws, customs, manners, religion, and policy; such an artificial structure required to be nicely and skilfully handled, in place of which it was lacerated in all its delicate parts by the rude hand of foreign interference. The English were ignorant even of the language of the people whom they had brought under their sway, and whom they now attempted to govern; and though they might know generally, that the public revenues were derived from an impost on land, they were entirely inexperienced in the usages of the country, and in the financial details of the Mogul government. They knew not through what an infinite variety of petty channels the land revenue was brought together, and at last poured into the imperial treasury. With what effect, therefore, could they interfere in such complicated details; how could they decide between the claims of justice and of fraud; how could they judge of cases connected with the peculiar usages of the country, and with all those minutiæ of local manners with which no foreigners can ever become thoroughly acquainted? The Company's servants, involved in such a labyrinth of complex concerns, possessed no clue to guide them to any equitable issue. Supposing their views to have been honest, they wanted intelligence to give them effect, and although they could enforce submission to their decrees, the country, under their usurped and ill-directed authority, presented one vast scene of anarchy and oppression. Nor was there any tribunal to which the oppressed could fly for relief; the Nabob, the nominal ruler of the country, being totally without power, and consequently unable to maintain

* See *Appendix to the Fifth Report* (printed by order of the House of Commons, 1812), *from the Select Committee on the Affairs of the East India Company*, p. 714, where, in the extracts from the Report of Mr Place, the reader will find a detailed view of the different rights and privileges, some of ownership, some of property, claimed by the inhabitants of the village.

† A lack of rupees is 100,000, a crore is 100 lacks, or ten millions. The rupee is worth about 2s. 3d.

the authority of his tribunals against the masters of the country. (Mill, Vol. II. p. 309.)

All those evils were readily ascribed by the Directors to the misconduct and rapacity of their servants, who, in their eagerness to make fortunes for themselves, totally neglected the interest of their masters; and this was no doubt true. But the objection of the Directors was, that they plundered the country for their own benefit, and not for that of the Company. Had the wealth acquired found its way into the public treasury, and been remitted to Europe in the form of a large investment, no such heavy complaints would have been made. The hope of receiving a surplus from their territorial revenues was, indeed, a delusion long and fondly cherished by the proprietors in this country. They expected to share among them the wealth of India. The land and labour of the country was to be laid under contribution for the benefit of its mercantile proprietors in Europe. The new sovereigns of India could never relinquish the notion of *profit*, the original object of their association. Their conceptions were never elevated to the true dignity of their situation. The glory of a sovereign consists in the felicity of grateful millions, and this is the only true and legitimate end of all government. But the East India Company were intent on profit,—on enriching themselves at the expence of their subjects; and the duty of the servants to their masters consisted in sending home a large investment. They were to possess themselves of as large a quantity as possible of the produce of the country, giving nothing in return, and to send it to Europe, to be shared among the proprietors; and it was, accordingly, the boast of successive administrations how well they had succeeded in this matter,—not how happy they had made their subjects,—but how much of their property they had taken from them and sent to Europe.

To realize the hopes of a large surplus revenue from India, the territorial revenues were racked to the utmost. The revenue contracted for in 1765 amounted to L.1,607,826; in 1766 and 1767, it amounted to L.1,713,677, from which deductions were afterwards made, as it was found impossible to collect it. The revenue, however, actually realized, exceeded the surplus formerly paid into the Mogul treasury when the country was in a flourishing condition. But the methods by which it was collected were ruinous to the country. The landholders, failing almost universally in their engagements, were left to the mercy of the revenue-officers, by whom they were grievously oppressed. In many parts the villages were deserted by the cultivators, and the land was left desolate. All those evils were still further aggravated by a grievous famine which prevailed in Bengal, in the year 1770, by which it is computed that about one third of the inhabitants perished. But, in the midst of all this misery, the revenue was still violently kept up to its former standard. The deficiencies occasioned by the famine were re-assessed on those who survived this calamity, and so strictly were they levied, that the land revenue for that year exhibited an increase above that of the year preceding. The ruinous effects of this heavy exaction are stated at length in the different letters from the Governor-General to the Directors. In a letter, dated 3d November 1772, he observes, "It was naturally to be expected that the diminution of the revenue should have kept an equal pace with the other consequences of so great a calamity; that it did not, was owing to its being violently kept up to its former standard." He then describes the method by which this was accomplished, which was by "an assessment upon the actual inhabitants of every inferior division of the lands, to make up for the loss sustained in the rents of their neighbours, who are either dead or have fled the country." "The tax (he continues) not being levied by any fixed rate or standard, fell heaviest on the wretched survivors of those villages which had suffered the greatest depopulation, and were of course the most entitled to the lenity of government. It had also this additional evil attending it, in common with every other variation from the regular practice, that it afforded an opportunity to the farmers, or sheidars, to levy other contributions off the people under colour of it, and even to increase this to whatever magnitude they pleased, since they were in course the judges of the loss sustained, and of the proportion which the inhabitants were to pay to replace it." To the same effect, Mr Middleton, one of the superintendents of the public revenue, observes, "When a very considerable portion, supposed even a third of the whole inhabitants, had perished, the remaining two-thirds were obliged to pay for the lands now left without cultivators. The country has languished ever since, and the evil continues enhancing every day. The first remedy, without the adoption of which all other measures will be fruitless, is an universal remission of some considerable portion of the revenue throughout the provinces. Such remission should have been made immediately on the famine. Its not taking place, then, has made it more and more necessary every day; and the longer it is delayed the more ruinous the consequences must be to this country and its revenue."

To correct these evils, numerous feeble remedies were devised. For the purpose of superintending the native officers, both in the collection of the revenue and in the administration of justice, which were intimately connected with each other in the Mogul Empire, the Company's servants were stationed in different parts of the country with the title of supervisors, and, to add to their security, two councils with authority over the supervisors were established, one at Moorshedabad, and another at Patna. "One of the most important duties of these supervisors was to procure information respecting the amount of the land revenues; the manner of collecting them; the amount of the cesses, or arbitrary taxes; the origin and progress of those modern exactions; and also to inquire concerning the regulations of commerce and the administration of justice. The reports made by these supervisors concurred with all the other evidence received as to the wretched and oppressed state of the natives. "The Nasims (they observed) exacted what they could from the zemindars and great farmers of the revenue, whom they left at liberty to plunder all below; re-

India.

serving to themselves the prerogative of plundering them in their turn, when they were supposed to have enriched themselves with the spoils of the country."

Consequences of the assumption of the management of the land revenue.

Such was the condition of the country when the Directors resolved to supersede the native government in the management of the land revenues. This resolution was adopted without any consideration how far their servants were qualified for the task of legislators among a people with whose manners, habits, and laws, they were totally unacquainted; and the latter, on their part, seem as little to have distrusted their qualifications for the duties assigned them. They resolved to make a settlement of the land revenues for five years, commencing from the year 1772. For this purpose, a committee of the board, consisting of the President and five members, named the "Committee of Circuit," was appointed, who were to make a journey through the country, and were empowered to receive proposals for a new lease of the lands, first from their ancient possessors, and, if their offers were deemed unsatisfactory, they were to be let by public auction to the highest bidder. These persons proceeded in their circuit through the country, publicly advertising and letting in farm, for the highest rent that could be obtained, the estates of such as hesitated to contract for the assessment proposed. A great proportion of the landed property throughout Bengal was thus exposed to auction; and, in the general sale, the former owners and the great nobility of the country were outbidden by adventurers, to whom property was acceptable on any terms, and were generally dispossessed of their lands, from the surplus produce of which a provision was assigned them by the indulgence of the revenue committee.

The supervisors who had been stationed in the different districts were invested with the necessary powers for the collection of the revenue, and were henceforth denominated collectors.* A native officer was to be joined with them under the title of duan, to confirm and to check accounts, and to assist in all those multifarious details which were intelligible only to a native. Various regulations were adopted to check the exertions of the collectors; but the governor and council express their regret that it was not in their power wholly to remedy this evil. (Mill's *British India*, Vol. II. p. 312.) Under the Mogul government, the duty of collecting the revenues and of administering justice was united, as formerly mentioned, in the person of the zemindars. The new scheme for the management of the revenues subverted this ancient order of things. The zemindar was superseded both as collector and as judge, and his place was supplied by two courts, the one for civil, the other for criminal proceedings, established in each district. In the criminal court the new collector of taxes was to act as president, to be assisted by two Mahometan officers, the cauzee and the muftee, and by two Mohlavies, as interpreters of the law. The civil court consisted, in like manner, of the collector as president, assisted by the duan and other officers of the native court. Two supreme courts were, at the same time, established at Calcutta, for the review of the inferior courts, both civil and criminal. To one of these all capital cases were reported, and were ultimately referred to the governor and council; who, finding the labour too great, restored, in 1774, this branch of administration to the nominal Nabob, and carried back the court to Moorshedabad. It appeared that, for a long period before this, the administration of criminal justice was wholly at a stand. In the new arrangements all disputes about property, not exceeding ten rupees in value, were referred to the head man of the district to which the parties belonged.

In considering those regulations, the question naturally occurs, how these supervisors, who were now to act in the double capacity of collector and judge, became qualified for the discharge of such important functions? In all other countries, it is only by a previous course of laborious preparation, that any one is qualified for the office of a judge, and to appoint an unqualified person would be reckoned both dangerous and absurd. But how much more dangerous and absurd was it to appoint uninstructed persons to act as judges in a foreign land, with whose language they are but imperfectly acquainted, and of whose laws, manners, and customs, they are thoroughly ignorant? If, among a comparatively rude people the mode of proceeding be loose and arbitrary,—if there be no books of written law, or of precedents to govern judicial decisions, which must consequently depend on the imperfect lights and analogies afforded by manners, religion, or customs, the incapacity of a foreigner for the discharge of such nice duties becomes even more glaring. By disposing of the administration of justice in this manner, it was clear, that the judicial duties would either be neglected, or that they would still be performed as before, and with no increased chance of amendment by native officers. This new arrangement was, therefore, like many others, a useless innovation on the established practice of the country. There is another weighty objection to the union in one person of the duties of collector and judge, namely, that it was in the collection of the duties that the grossest oppression had been committed; the powers of the collectors being frequently perverted to the most iniquitous ends. Under this new project those who sought redress from the courts of justice, met with their oppressor in the capacity of judge. He judged in his own case and of complaints brought against his own conduct. Justice was in this manner an empty name, unless it was supposed that the judge would pronounce himself an oppressor.

Under the five years' lease on which the land revenues had been farmed in 1772, the country was grievously overtaxed. The revenues fell into a heavy arrear the very first year, and the lands were let on a progressive rent. To collect the outstanding balances, and to force up the revenue to its standard, a host of extortioners was, under the name of Aumils, or collectors, let loose upon the afflicted country. But the rents contracted for by the farmers of the revenue were greater than they could pay, and, notwithstanding all their efforts, the arrears continued to increase. On the five years' lease, they amounted to a sum equal in value to L.1,454,277, which was judged to be wholly irrecoverable; while, during the same period, the sums remitted, even under the rigorous management of public farmers, amounted to L.1,336,451. Nor was this the only

India. evil arising from the mal-administration of the Company's servants. The zemindars, who are admitted on all hands, even by those who advocate the sovereign's right to the possession of the soil, to have lived in splendour on their hereditary possessions,—in all cases to have possessed the powers of magistracy within their district, and where the territory was large, to have exercised a species of sovereignty,—were either despoiled of their estates, or, where they were induced, by a hereditary attachment to their possessions, to engage for the rent proposed, they were overwhelmed with taxes which they could not pay, and were thus involved in poverty and ruin. Where the zemindar was himself the farmer of the revenue, he exercised the same extortion on his inferiors which was applied to himself; where a money jobber, who had no interest whatever in the property of the tenants, was the farmer, there was no limit to his extortion and cruelty.

The defects in this system for the administration of the land revenues soon began to disclose themselves; and the rulers of India, whose government was one continued innovation, immediately resolved to make another considerable change in the state machinery, which they had just set in motion. They abolished the superintendence of the collectors, and the country, with the exception of Chittagong and Tipperah, being formed into six grand divisions, viz. Calcutta, Burdwan, Moorshedabad, Dinazepore, Dacca, and Patna, a council was appointed for each of the last five, consisting of a chief and four senior servants, to whom were transferred the powers and duties of the collectors. They were to preside in the courts of justice, and to superintend the collections; and, in subordinate districts, they delegated their powers to naibs or aumils, who were natives, and who were appointed, like their superiors, to collect and to judge in all cases under the value of 1000 rupees. The empty privilege of appeal was, as formerly, reserved to the unsuccessful suitor in the provincial courts, and to superintend the whole collections of the country, a grand revenue-office was established at the presidency. The district of Calcutta was placed under the peculiar superintendence of a committee of revenue, consisting of two members of the Council and three inferior servants. These regulations, which were declared to be temporary, and only preparatory to something more permanent, failed as usual in all their important objects. The defective administration of justice among the natives was admitted and complained of by all parties, and the peace of the country was in consequence disturbed by the general prevalence of robbery and other enormous crimes. The truth is, that the new arrangements had subverted the ancient institutions and local manners of the country, and had thus left a void in its internal economy which the Government was in vain endeavouring to fill up.

The lease of the lands expired in 1777; and, after various suggestions and consultations, it was resolved that the rent should be regulated by the average collections of the three preceding years, and that the lands should be let, not by auction, but by an agreement with their ancient possessors in preference to other competitors. The liberal views of Mr Francis, who proposed that, in lieu of the monopoly of salt and opium, a moderate duty should be imposed on those articles, and that a long series of oppression should thus be terminated, by giving freedom to trade, were rejected by the Governor-General. In pursuance of the plan proposed, the lands were let from year to year until the necessary arrangements could be completed for the system which was now to be adopted of a permanent land-tax.

New System of Government for India established by Parliament.

The attention of the British Parliament had frequently been directed to the state of our Indian possessions, and to the transactions of the resident government; and, in 1784, a new system was established in Britain for the control of the local administration, under which, Lord Cornwallis, who was chosen Governor-General, was specially directed by the act of Parliament, as well as by instructions from the Directors and the Board of Control, "to inquire into the alleged grievances of the landholders, and, if founded in truth, to afford them redress; and to establish permanent rules for the settlement and collection of the land revenue, and for the administration of justice, founded on the ancient laws and local usages of the country."

Lord Cornwallis, on his arrival in India, did not deem matters fully ripe for the execution of the proposed plan, namely, the permanent settlement of the land revenue. On this important subject he found a great difference of opinion among the most intelligent of the Company's servants. Neither the nature of the land tenure, nor the rights of the different orders of people, who shared among them the produce of the soil, were sufficiently understood. All that was distinctly known was the amount of the revenue; but whether it was too high or too low was still a point in dispute among the English in India. In such wide diversity of opinion, the Governor-General was naturally anxious to proceed with caution, and to delay for some time the plan of a permanent settlement. The lands were, in the mean time, let from year to year through the agency of the district collectors, and information on which to found a more durable arrangement was diligently sought from every source.

Plans of Lord Cornwallis regarding the Revenue.

In 1789, Lord Cornwallis had matured his plans for the permanent settlement of the land revenues. This he now conceived to be the only measure that could retrieve the country from its present condition, which he described to be wretched in the extreme. "I am sorry (he observes) to be obliged to say, that agriculture and internal commerce have for many years been gradually declining; and that at present, excepting the class of Shroffs and Banyans (bankers and merchants), who reside almost entirely in towns, the inhabitants of these provinces are advancing hastily to a general state of poverty and wretchedness. In this description I must even include every zemindar in the Company's territories; which, though it may have been partly occasioned by their own indolence and extravagance, I am afraid must also be in a great measure attributed to the effects of our former system of management."—"I may safely (says he) assert, that one third of the Company's territory in Hindostan is now a jungle, inhabited only by wild beasts." So thoroughly persuaded was Lord Cornwallis of the necessity of a permanent settlement of the land re-

India.

venues, with a view to the improvement of the country, that the agreement with the landholders, at first made for ten years, was afterwards declared unalterable; and the zemindars of Bengal, Bahar, and Orissa, were formally constituted legal and perpetual proprietors of their respective estates on the payment of a fixed rent to the state. The ten years, or, as it is called, the *Decennial settlement*, was completed in every district in 1793, and was afterwards extended to the conquered countries.

Plans of Lord Cornwallis regarding the Civil and Criminal Judicature.

Along with the decennial settlement Lord Cornwallis also introduced other important reforms in the administration of civil and criminal justice. The union of the duties of tax-gatherer and judge had produced, as might have been expected, the most glaring abuses. The tax-gatherer not only officiated in many cases as his own judge, but where the duties of the two offices happened to interfere, which was often the case, it invariably happened that the one was discharged by the neglect of the other. It was now proposed to separate those incompatible functions, and to establish in each district of the country, and in all the considerable towns, a civil court, in which one of the Company's servants, higher in rank than the collector, should act as judge, to be assisted by a register, and one or more of the junior servants of the Company, and also by a native expounder of Hindu or Mahomedan law. The judge was authorized to refer all cases of inconsiderable importance to his register, from whom there lay an appeal to himself; and for determining suits regarding personal property, not above the value of 50 rupees, courts of native commissioners were established in every district, to decide in a summary manner. From this inferior court of law there lay an appeal to the court of the district, whose decision was final, except in cases of real property, or in the event of the decision of the inferior court being reversed. A new scheme of appellate jurisdiction was also introduced. All causes involving property above the value of 1000 rupees might formerly be appealed to the Governor-General in council. This court, however, was found to be useless to the natives, whose disputes never involved property to such an amount, and who, as the court was established in Calcutta, could not afford the expence of such distant litigation. To remedy this grievance, Lord Cornwallis established four tribunals of appeal; one in the vicinity of Calcutta, and one at Patna, Dacca, and Moorshedabad. In these three the Company's servants were to sit as judges, to be assisted by a register, and one or more of the junior servants of the Company, and by three expounders of native law. To these, which were styled provincial courts, the privilege of appeal was eventually given from all the decisions of the inferior tribunals. To complete these arrangements, a court of supreme jurisdiction was established at Calcutta, composed of the Governor-General, and the members of the superior council, with suitable assistants both English and natives. The former exaction of 2½ *per cent.* by the judge on all litigated property was abolished, as well as the impost on the commencement of the writ, and all fees of court.

Such were the arrangements adopted by Lord Cornwallis for the reformation of the civil judicature in India. The criminal department he describes as being replete with still more disgraceful corruption. In a letter to the Directors, dated 17th November 1790, he observes, "Your possessions in this country cannot be said to be well governed, nor the lives and property of your subjects to be secure, until the shocking abuses, and the wretched administration in the criminal department, can be corrected. Anxious as I have been to apply a speedy remedy to evils so disgraceful to government, so ruinous to commerce, and, indeed, destructive to all civil society, it has still appeared to me to be so important as to make it necessary for me to act with great circumspection." For the purposes of criminal judicature, four tribunals were established, in which the judges of appeal in the provincial courts were appointed to act, and were provided with the same assistants, as in the civil courts. They were to make regular circuits through the country, holding a session for jail delivery at the four principal cities of Calcutta, Patna, Dacca, and Moorshedabad, every month, in the district of Calcutta four times, and in the remaining districts of the country twice in the year. The judges in the four courts of appeal were to form two courts of circuit. The inconvenience of devolving both the civil and criminal business on the same judges was soon heavily felt, and, in 1797, after some previous arrangements, which had been found inadequate, two of the judges were specially appointed to the business of the civil appeal court, while only one was left for the business of the circuit. In addition to these arrangements, a criminal tribunal, of supreme jurisdiction was established at the seat of government, composed in the same manner as the supreme civil court of the Governor-General and members of the Supreme Council.

Errors and Defects of Lord Cornwallis's Plans and generally of our Indian Government.

In regard to the plan for the permanent settlement of the land revenues, which demands our first consideration, it may be remarked, that, in the imposition of a land-tax, the great danger is, not that it be too small, but that it be too large, and this evil ought more especially to have been guarded against in framing an assessment that was to be fixed and invariable. Lord Cornwallis, in calculating that permanent possession, on payment of an invariable tax, would afford a sure encouragement to cultivation, did not sufficiently consider that this altogether depended on the amount of the tax. The invariable rate of a tax is a benefit to a country exactly as it is moderate or otherwise. In the one case, it is satisfactory to know that it cannot be increased, while, on the other hand, the invariable rate of an oppressive tax is a great additional calamity, as it shuts out from the country all hope of relief. Here, then, was one obvious and capital error in the scheme, namely, that a permanent land-tax was imposed without any equitable standard to fix its amount. The legislators of India had not yet acquired the necessary knowledge of the country for such a measure. They had no data on which they could, with any certainty, adjust the tax to the capacity of the soil; and, after long discussions, it was at length fixed at the average amount of the collections for the last three years. But it had been a general complaint, that the country was overtaxed; and to this cause was ascribed its misery and decline

From this high standard of taxation, no systematical reduction had ever been made. Arrears, which had been long accumulating, and which could not be recovered, had, indeed, been remitted; but every method of extortion had been practised in order to realize as large a revenue as possible; and the country was now charged with a permanent assessment, founded on the actual revenue of those years. The invariable rate of the tax was, in this case, no benefit to the country; and, in order to receive the advantages supposed by Lord Cornwallis to arise from permanent possession, he should have assured himself of the moderation of the tax imposed. In place of this, it was exorbitant, and greater than the land could bear; and this radical defect, even if there had been no other, would have ensured the failure of the plan. The zemindar, who was bound, in the first instance, for the public tax, depended, for the means of discharging it, on the produce of his rents; and the state, by imposing an immoderate tax on him, laid him under the necessity of practising similar extortion on all below him. The example of the government was a general warrant for extortion, which, once begun, would necessarily descend from the proprietor to the lowest tenant.

There was another important defect in the plan of the decennial settlement, namely, that it seemed to rely entirely on the exertions of the zemindars for the improvement of the country. No attention was given to secure the under-tenants and ryots in the hereditary privileges which they claimed in the soil. As they varied in different places, and depended on different rules, the subject appeared to involve details too troublesome and intricate for European management; and the important task of settling with the ryots was, therefore, devolved on the zemindars, with a mere general recommendation to be guided by the custom of the place, and to give the ryot a written copy of his lease. According to this plan, it was the great proprietors only who had any permanent interest in the lands, while the inferior proprietors and tenantry were at the mercy of the principal landholders, who might exact from them whatever they pleased. The under-tenants and cultivators, in this ill-defined state of their rights, had no interest whatever in the improvement of the soil; being well assured that, however abundant the produce of the soil might prove, they would be left nothing more than a bare maintenance. But it is not agreeable to experience, that the cultivation of any country was ever materially forwarded by the exertions of its great lords. On the contrary, it is their character generally to be inactive, wasteful, and improvident, while the improvement of the land is invariably the work of the cultivators and tenantry, to whom, however, the plan held out no sort of encouragement. Though humanely intended, therefore, it was calculated to entail ruin upon the higher classes of landholders by the tax which it imposed on them; while by necessitating them, and, at the same time, giving them the power to oppress all below them, in order to satisfy the exorbitant demands of the state, it necessarily had the effect of extending this ruin downwards to the lowest tenant. Its effects have entirely corresponded to the view of its principle.

It soon appeared that, in order to realize the revenue, it would be necessary to sell the lands; and this evil once begun continued to increase. The revenue was not punctually paid, and for the recovery of outstanding balances lands to a great amount were at stated times exposed to auction. In the year 1796-7, the lands advertised for sale bore a rent of 2,870,061 sicca rupees (L.332,927); and those actually sold yielded an annual rent of 1,418,756 rupees (L 164,576). In 1797-8, the quantity of land sold bore a rent of 2,274,076 rupees (L.255,833), and it is observed in the *Fifth Report*, p. 56, that "among the defaulters were some of the oldest and most respectable families of the country;" "the dismemberment of whose estates," the report continues, "at the end of each succeeding year, threatened them with poverty and ruin, and, in some instances, presented difficulties to the revenue officers in their endeavours to preserve undiminished the amount of the public assessment." In order to check those evils, several alterations were made from time to time by Lord Cornwallis. But they appear to have been unavailing, and, in the year 1802, in a report from one of the collectors, we have the following melancholy picture of the state of the country:—" 'All the zemindars,' it is observed, 'with whom I ever had any communication, in this and in other districts, have but one sentiment, respecting the rules at present in force for the collection of the public revenue. They all say, that such a harsh and oppressive system was never before resorted to in this country; that the custom of imprisoning landholders for arrears of revenue was, in comparison, mild and indulgent to them; that though it was no doubt the intention of government to confer an important benefit on them, by abolishing this custom, it has been found by melancholy experience, that the system of sales and attachments, which has been substituted for it, has, in the course of a very few years, reduced most of the great zemindars in Bengal to distress and beggary, and produced a greater change in the landed property than has perhaps ever happened, in the same space of time, in any age or country, by the mere effect of internal regulations.' (*Fifth Report*, printed in 1812, p. 60.) In another part of the same document, the collector, after commenting on a regulation then recently introduced, observes, 'Before this period (1799), complaints of the inefficacy of the regulations were very general among the zemindars, or the proprietors of large estates; and it required little discernment to see, that they had not the same powers over their tenants which government exercised over them. It was notorious, that many of them had large arrears of rent due to them, which they were utterly unable to recover; while government were selling their lands for arrears of assessment.' The collector adds, 'Farmers and intermediate tenants were, till lately, able to withhold their rents with impunity, and to set the authority of their landlords at defiance. Landholders had no direct control over them; they could not proceed against them, except through the courts of justice, and the ends of substantial justice were defeated, by delays and cost of suit.'" To the same purpose, Sir Henry Strachey observes, "That the men

India. of opulence are now all men of yesterday; that the greatest men formerly were the Mussulman rulers, whose places we have now taken, and the Hindoo zemindars. These two classes are now ruined and destroyed." (See *Answers to the Interrogatories of Government*, dated 30th Jan. 1802.)

One cause which undoubtedly contributed to the ruin of the zemindars, was the want of any effectual method of enforcing their claims, against the small tenants. For the purpose of duly collecting the revenue, the public officer was empowered to proceed against defaulters by a summary process,—and to attach and sell, by public auction, the zemindar's land for the discharge of arrears; while against the under-tenants, the zemindar had to seek redress by an ordinary suit at law, which was both tedious and expensive. To heighten this evil, the courts of justice were overloaded with a long arrear of undecided causes, so that no decision could be expected, before the lapse of years. In the district of Burdwan, the undecided suits were said to amount to 30,000, and the probability of a decision in any suit was estimated to exceed the ordinary duration of human life. The zemindar, in this manner, while he was compelled to pay, by the prompt and efficient process of government, was left to seek redress from his tenants through a labyrinth of endless litigation, and the knowledge of this impediment to justice gave great encouragement to the tenants to refuse payment of their rents. The ruin of the zemindar, therefore, was the inevitable consequence of those measures, which levied on him a heavy assessment by the most summary process, while he was restrained from levying on his tenants the means of its discharge. The zemindar was the channel through which the land revenue flowed into the treasury. He paid what he received, reserving a small surplus for himself; but to pay what he did not receive was impossible. The injustice, then, and the folly of the present measures, consisted in the means adopted to make the zemindar pay, while no means were given him of making others pay to him; in establishing a regular drain on the zemindar's treasury, and at the same time in withholding from him the means of insuring an equally constant supply. These regulations were universally complained of, and on the justest grounds. In an address from one of the collectors to the board of revenue, in behalf of the zemindar of Burdwan, who had in vain applied for redress to the civil courts, it is observed, that he (the zemindar) begs leave to "submit to your consideration, whether or not it can be possible for him to discharge his engagements to government with that punctuality which the regulations require, unless he be armed with powers as prompt to enforce payment from his renters, as government had been please to authorise the use of, in regard to its claims, on him; and he seems to think it must have proceeded from an oversight, rather than from any just and avowed principle, that there should have been established two modes of judicial process, under the same government; the one summary, and efficient for the satisfaction of its own claims; the other tardy and uncertain in regard to the satisfaction of claims due to its subjects; more especially in a case like the present, where ability to discharge the one demand necessarily depends on the other demand being previously realized."

The system which impoverished the zemindars was equally ruinous to the ryots. It was the practice of the zemindar to contract for a certain rent with a land farmer, who subdivided the land into smaller portions, and let it to a variety of inferior tenants. To this head farmer, it appears that a written agreement was given, according to the regulations; but the under-tenants were left, without any security, to the mercy of their superiors. It is well known, and admitted by the servants of the Company, that the ryot, even when he receives written agreements from the zemindar, is liable to indirect oppressions which no law can remedy; and though, owing to the expence and delay in the administration of justice, he could retaliate on the zemindar, by refusing payment of his rents, this privilege could be of little advantage to him, while it tended still farther to widen the breach between the landlord and the tenant, and to add to the hatred, strife, and violent distraction of interests by which the community was now, as it were, torn in pieces. To remedy the grievances which the zemindars suffered from the evasion of payment by their tenants, it was enacted in 1799, that they might have recourse to the same summary process against defaulters, as was tried by the government against themselves. They were empowered to seize the property of their tenants for arrears, previous to any legal judgment, or any proof of the justice of their claim. This regulation gave to the zemindars the power of unbounded oppression, against which the ryot had no redress, as he was effectually shut out of the courts of justice, by the enormous expences of law proceedings.* It was undoubtedly just that the zemindar should have the same efficient process for enforcing payment as was used against himself; but such was the unhappy condition of India, under the unskilful management of strangers, that every plan of reform seemed only to increase the general disorder. Her rulers wanted intelligence for the delicate task of domestic legislation; their schemes were crude and inapplicable, nor could they ever mould the various and jarring interests of the Indian community into any consistent scheme of civil order; so that, though they were continually patching their imperfect work, it still bore the same incongruous character, and the cure of one evil was constantly followed by an irruption of other and worse evils from some other quarter.

The institutions of Lord Cornwallis, for the administration of civil and criminal justice, appear to have been equally unsuccessful with his finance measures; and it soon appeared, as has been already stated, that the new courts of judicature had more business than they could manage, and such an arrear of undecided cases accumulated, that the course of

* All the collectors invariably bear testimony to the oppressions of the zemindars, after the passing of the regulation of 1799.

India. justice was nearly stopt. In this dilemma, the costs of suit were raised for the purpose of discouraging litigation; and this expedient being found ineffectual, they were raised a second time. To place justice out of the reach of the poorer and more numerous class, by laying a heavy tax on it, was indeed an easy and effectual method of discouraging litigation. It was, in fact, a denial of justice,—a direct refusal to hear the complaints of the poor, who might, therefore, be harassed for ever after with impunity. Notwithstanding this discouragement, however, the evil went on increasing, and at last amounted to an almost total dissolution of civil order. As no decision was to be procured before the regularly constituted tribunal, every man began to arm himself in his own quarrel, and the country thus became the scene of bloody affrays between armed individuals unhappily left without any other resource for the decision of their differences. In some of those conflicts 4000 or 5000 persons were arrayed on each side, and many lives were lost. In a letter of the Court of Directors, dated October 1814, it is observed, "As to affrays respecting the possession and boundaries of lands and rents, this has been long a serious evil, and must, we conceive, have existed in a greater or less degree in every part of the country."—"These affrays," continue the Directors, "which often lead to homicides and woundings, have been very naturally ascribed by several of the judges to the difficulty of obtaining judicial redress."* In the district of Tirhoot, where the public peace had been frequently disturbed by those private feuds, the judge, for the division of Patna, observes, that they chiefly "arose from the accumulated arrears of suits," and "that the parties finding a delay in obtaining redress, had resorted to force."† Mr. Melville, also a judge in the division of Dacca, expresses himself to the same purpose. "With respect to affrays (he observes) attended with homicides and wounding, it is known that those disorders arose from attempts to retain by force possession of lands, or rents of lands, to which the different parties alleged separate claims." The same person afterwards states, that "in Chittagong, they (meaning these quarrels) had not only been frequent, but violent; that the police authority had been often resisted, and in one instance overpowered; that it would be wrong to disguise the length of time a claimant must wait, with the sacrifices he must make, before the decision of a civil court can be obtained."

We shall now briefly advert to the system of penal judicature and police established by Lord Cornwallis; the object, in this case, being to give security to the people by the suppression of crimes. With reference to this object, however, the scheme has notoriously failed. Since the year 1793, India has become a prey to disorders of every sort, and to the worst of crimes. Violence and depravity seem to have overspread the land, and to have produced an almost universal dissolution of morals among the people. The crime of robbery, accompanied with murder, had risen to a most alarming height in India, and was prosecuted with a degree of union, perseverance, and cruelty, inconceivable to those who live in the civilized communities of Europe. Robbery is a regular profession, which is handed down from father to son; and the decoits, or gang-robbers, are formed, as the title implies, into powerful confederacies, and make their irruptions on the peaceful country with a force which it is vain to resist. They are described by Mr Hastings as "a race of outlaws, who live from father to son in a state of warfare against society, plundering and burning villages, and murdering the inhabitants." In the year 1772, the robbers are mentioned by the Committee of Circuit, and stated to be "not like robbers in England, individuals driven to such courses by sudden want; they are robbers by profession, and even by birth; they are formed into regular communities, and their families subsist by the spoils which they bring home to them.

All the reports of the judges employed in the administration of criminal justice concur in representing the deplorable prevalence of the atrocious crimes of gang-robbery and murder. Sir Henry Strachey, writing on this subject in 1802, observes, that the crime of decoity (that is, robbery by gangs) has increased greatly since the British administration of justice. Another judge, writing on the same subject in 1808, observes, "That decoity (gang-robbery) is very prevalent in Rajeshahye has been often stated. But if its vast extent were known: if the scenes of horror, the murders, the burnings, the excessive cruelties, which are continually perpetrated here, were properly represented to government, I am confident that some measures would be adopted to remedy the evil. Certainly, there is not an individual belonging to the government, who does not anxiously wish to save the people from robbery and massacre. (Mill, Vol. III. p. 311.) He afterwards adds, that such is the state of things which prevails all over Bengal, and as to his own particular district, he expresses his persuasion that no civilized country ever had so bad a police. To the same purpose, Mr Dowdeswell, the secretary to the government in 1809, observes, in a Report which he drew up on the general state of Bengal, "Were I to enumerate only a thousandth part of the atrocities of the decoits, and of the consequent sufferings of the people; and were I to soften that recital in every mode which language would permit, I should still despair of obtaining credit, solely on my own authority, for the accuracy of the narrative." "Robbery, rape, and even murder itself (he continues), are not the worst figures, in this horrid and disgusting picture. An expedient of common occurrence with the decoits, merely to induce a confession of property, supposed to be concealed, is, to burn the proprietor with straw or torches, until he discloses the property, or perishes in the flames. And when they are actuated by a spirit of revenge against individuals, worse cruelties, if worse can be, are perpetrated by these remorseless criminals. If the informa-

* See *Papers relating to the Police and Administration of Justice in Bengal, from* 1810 *to the present time.* Printed, by order of the House of Commons, 1819, p. 21.

† Ibid. p. 22.

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tion obtained is not extremely erroneous, the offender, hereafter noticed, himself committed fifteen murders in nineteen days: And volumes might be filled with the atrocities of the decoits, every line of which would make the blood run cold with horror." (*Fifth Report*, p. 603.)

It would far exceed our limits to trace in detail the cause of these evils, which necessarily arose out of the very nature of the government now established. The truth is, the British were never qualified to act as legislators in India. They were too ignorant of the habits, manners, and character of the people to meddle with their institutions, on which, however, they were continually innovating. By altering the old mode of settling the land revenues, they compromised the rights of the different classes of landholders and occupiers. Strife and contention immediately ensued,—litigation burst upon society like a flood,—the civil courts were overwhelmed with suits which they could not decide, and the people, desperate from a denial of justice, were involved in furious affrays with each other in prosecution of their rights, or, being driven from their lands, they had recourse to robbery for a subsistence. Business was thus, from various sources, accumulated in the criminal courts, which being encumbered with the delay, the expence, and all the tedious formalities of the English practice, proceeded with their decisions at much too slow a pace for the wants of the country; and the evil in this manner daily increased. The mischief of this delay was twofold; 1*st*, It allowed criminals, during the long interval between their apprehension and trial, to prepare the certain means of their escape, by the suborning of false witnesses, who, in the gross dissolution of morals which now prevailed, were always to be readily procured, and in any number; and, 2*dly*, It entailed a grievous hardship on the innocent, great numbers of whom were crowded into jails with the worst of felons, there to wait until the tardy hand of justice should bring them relief.

The inefficient state into which the police had fallen was also one cause of the general prevalence of crimes. By the ancient institutions of the Mogul government, ample means were provided for the preservation of the public peace. In every village a permanent body of guards and watchmen was maintained, whose business it was to assist in all the subordinate details both of the revenue and police—to convey the rents of the ryot to the district collector—to watch those ryots who were in arrear—to guard their crops from depredation—to act as guides and protectors to travellers—to collect information of any offences committed—and to report the arrival in the villages of suspicious persons. For these various services they had grants of land rent-free, or on very easy terms. Besides this standing force of guards and village watchmen, the zemindar, who was at the head of the police, and was held responsible for all crimes committed within his boundaries, had under his orders a large body of *pykes* or armed constables, whom he could call out in aid of the police service, either for the apprehension of offenders, or to prevent breaches of the peace. These establishments, though they had fallen into a state of disrepair at the time of the permanent settlement in 1793, and though they were frequently perverted from their original purposes, yet existed in all parts of the country, and the police force was found to be in great efficiency and strength. The zemindary of Burdwan, a tract of country 73 miles long by 45 broad, which was in the highest state of cultivation, and well stocked with inhabitants, maintained a body of 2400 village watchmen, who were distributed under their respective chiefs among the different villages, for the double purpose of protecting the inhabitants, and of procuring information; besides 19,000 *pykes* or armed constables, who were liable to be called out, under the orders of the zemindar, in aid of the police. In place of improving upon those ancient establishments which had taken root in the country, which were interwoven with the frame and texture of Indian society, and which were, generally speaking, efficient, though frequently perverted from their original purposes, Lord Cornwallis demolished the whole structure. According to his new scheme of police, the zemindary constables were disbanded, and their lands, which were allowed them in lieu of pay, were resumed, *i. e.* were seized by government. The country was divided into districts of 20 miles square, over which a native police officer, or darogah, was placed, with 15 or 20 armed men under his orders; he was assisted also by the village watchmen, and such of the zemindary constables as were still retained in the public service. It was soon found, however, that the new police officers could not effectually call out this array in aid of the civil power. They wanted the personal consideration of the zemindars, who had been long looked up to with respect and reverence as the hereditary aristocracy of the country. The system proved, therefore, eminently inefficient, nor were the officers employed under the new plan found to be less corrupt than the disbanded constables of the zemindars. The merits of the plan appear to be pretty fairly estimated in the *Fifth Report*, p. 71, in which it is observed, that the head police officers, and "the inferior officers acting under them, with as much inclination to do evil, have less ability to do good, than the zemindary servants employed before them." How vain was it to imagine, that any better materials could be found for the regulation and government of the country than those which the country itself afforded! To complain of them was to complain of the general state of society out of which they were produced; and to throw them away, because they are corrupt or otherwise imperfect, evinces an ignorance of the legislator's province, which is not to create materials, but to make the best use of those which are provided to his hand. Herein, then, consisted the error of the British legislators. They cast from them the only efficient instruments which were to be found for the government of the Indian community, while they had nothing to substitute in their place; and their plans, when tried in practice, were accordingly found to be idle theories, at variance with the whole frame and order of the society for whose use they were intended.

The pernicious consequences of thus rashly subverting the ancient establishments of the country were soon displayed in the alarming increase of crimes. The disbanded zemindary constables, whose lands were seized, were deprived of the means of

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India.

living, and they necessarily betook themselves to theft and rapine for a subsistence. The country became infested with gangs of robbers and murderers, whose horrid cruelties struck terror into the peaceable inhabitants, while lesser crimes also became more frequent. The police was inadequate to the detection of offenders; the courts of justice to their conviction; and, among other evils, a host of false witnesses now arose, amid the general corruption of morals, who swore in the teeth of each other, perplexing all judicial proceedings, and confounding the innocent with the guilty. For remedy of these complicated evils, various expedients were resorted to. Among others, a feeble attempt was made to revive the ancient powers which the zemindars had over the police; but this was attended with so little success that it was abandoned in 1810. In 1808 a superintendent of police was appointed with a view of concentrating, as was stated, in his office, all the information which might be obtained from different quarters, and of giving unity and vigour to the measures adopted for the apprehension of offenders; and as a last resource, a regular establishment of police spies, called *goyendas*, was organized, and placed under a species of superintendents, called *girdwars*, the office of the first being to point out the robbers, that of the latter to apprehend them. Notwithstanding all these measures, crimes of every description appear to have gone on increasing, and, in a minute of Lord Minto, dated November 1810, it is observed, "that a monstrous and disorganized state of society existed under the eye of the supreme British authorities, and almost at the very seat of that government to which the country might justly look for safety and protection; that the mischief could not wait for a slow remedy; that the people were perishing almost in our sight; that every week's delay was a doom of slaughter and torture against the defenceless inhabitants of very populous countries." The Directors, in whose letter of the 28th October 1814 this passage appears, confirm the truth of the statement by the following brief observation:—"That this representation of the late Governor-General is not too highly coloured, would appear from the minute of Mr Lumsden, and the reports of Mr Secretary Dowdeswell, forming also part of the proceedings in regard to Mr Ernst."*

The new scheme of organizing a body of professed spies in the service of the public, while, in some cases, it was of public benefit, was, in other respects, highly detrimental to the peace of the community. Those spies, and more especially their superintendents (*girdwars*), became, in many cases, the pests of society. They took advantage of the power which they possessed of apprehending suspected persons, to extort money from them; and frequently, under threats of immediate apprehension, they laid under contribution all classes indiscriminately. It is stated, in a letter of the Directors, dated October 1814, on the authority of Mr Dick, a circuit judge, that "whole villages are put under contribution, or subjected to the rapacity and spiteful machinations of the vilest members of society."† In some cases, the innocent were brought to trial, and convicted, on suborned evidence, procured by these wretches.

Among the other causes of these evils may be enumerated the incapacity of Europeans to officiate as judges in a society so peculiarly constituted as that of India, with the usages and manners of which, as well as with the general character of the people, they remain to this day in a great measure unacquainted. This is a fact which is deeply regretted by all the most experienced servants of the Company, from Sir John Shore downwards. Europeans are sent out to India with the sole view of amassing a fortune. They have no interest in the country from which they draw such important benefits. They know nothing of its habits and manners—never mixing with the natives in their ordinary business or amusements—and never attaining to more than a theoretical knowledge of their characters. With such qualifications, they begin to officiate as judges, how miserably ill-appointed for such an office their own experience quickly teaches them. They soon find the difficulty of appreciating or understanding even the most ordinary transactions of a society, with the rules and principles of which they are entirely unacquainted. What is intelligible by intuition to a native is a mystery to them; and it is easy to conceive how these difficulties must be accumulated on them in any long process of criminal judicature, involving a train of circumstantial, and frequently of contradictory evidence. It is not, as every one knows, on the mere naked testimony of a witness that a judge entirely relies; it is the tone, the manner, the living evidence of expression and character, which impresses upon testimony the stamp of truth; which carries conviction to the mind; and saves a judge from the miserable dilemma of being blown about by every wind of opposite evidence. These discriminations are, however, far too nice for a European judge in an Indian court, and he frequently knows not what to believe. He cannot, by any judicious cross-examination, extort the truth from contradictory witnesses. In any train of questions involving the peculiar usages of the country, his stock of knowledge is soon exhausted. A story which hangs together in all its main circumstances, may yet be inconsistent in some of its minute and delicate points. But a European can never detect inconsistencies which are wrapt up in the veil of local manners. He lies, in this manner, at the mercy of every perjured witness who chooses to practise upon his ignorance. The truth of this statement is illustrated and confirmed by the concurring reports of many of those who have acted in this trying situation. Sir Henry Strachey, whose reports to the supreme government abound in most just, enlightened, and comprehensive views of Indian society and manners, observes, that "nothing is more common,

* See *Papers relating to the Police and to the Administration of Civil and Criminal Justice in Bengal. Fort George*, &c. from 1810 to the present time, printed in 1819, p. 24.

† *Papers printed by order of the House of Commons*, 1819.

even after a minute and laborious examination of evidence on both sides, than for the judge to be left in utter doubt, respecting the points at issue. This proceeds chiefly from our very imperfect connection with the natives, and our scanty knowledge, after all our study, of their manners, customs, and languages. Within these few years, too, the natives have attained a sort of legal knowledge, as it is called, that is to say, a skill in the arts of collusion, intrigue, perjury, and subornation, which enables them to perplex and baffle us, with infinite facility."—"We perhaps judge too much by rule—we imagine things to be incredible, because they have not before fallen within our experience. We make not sufficient allowance for the loose, vague, and inaccurate mode in which the natives tell a story,—for their not comprehending us, and our not comprehending them. We hurry, terrify, and confound them, with our eagerness and impatience."—"We cannot (says the same discriminating observer) study the genius of the people in its own sphere of action. We know little of their domestic life, their knowledge, conversation, amusements, their trades and casts, or any of those national and individual characteristics, which are essential to a complete knowledge of them. Every day affords us examples of something new and surprising; and we have no principle to guide us, in the investigation of facts, except an extreme diffidence of our opinion, a consciousness of inability to judge of what is probable or improbable."—"The evil I complain of is extensive, and, I fear, irreparable. The difficulty we experience in discerning truth and falsehood among the natives, may be ascribed, I think, chiefly to our want of connection and intercourse with them; to the peculiarity of their manners and habits, their excessive ignorance of our characters, and our almost equal ignorance of theirs." The following passage, from the same document, gives a striking view of the inefficiency of European judges. "The evidence on every trial convinces us, that innumerable robberies and murders, that atrocities of the worst conceivable kind, are committed; and that very often the perpetrators are before us; yet do we find ourselves, from causes of the nature above described, constrained to let them loose again, to prey on society; or, at the utmost, to direct that they be discharged, on giving security for their good behaviour."—"The judge of circuit is from day to day engaged in trying large gangs for robbery and murder, and letting them go; and the country continues to be overrun with them, to a degree truly deplorable." *(Answers to Interrogatories of Government, 30th January 1802. Fifth Report.)*

It is well known that, according to the rules of the Company's government, no European is allowed to acquire landed property in India, and that all colonization of the country is studiously discouraged. The European rulers of India could not possibly pursue a more weak and pernicious policy, by which all the other errors of their administration are aggravated; which marks their own jealousy of their subjects, and evinces a disposition to hold possession of the country by any means, however exceptionable. The effect of the Company's government in India, as appears from the preceding review of its measures, has been to destroy the hereditary aristocracy of the country. All the great families have disappeared, under the rigid exactions of revenue to which they were exposed; their estates have been sold, and they are confounded among the mass of the people. The extinction of this important order of men, and the want of that natural influence which they possessed, is severely felt in every branch of the public management. The business of the revenue, the magistracy, and police, have, as has been shown, fallen into a state of almost irreparable disorder; and these evils are, by all the most experienced servants of the Company, and by the Directors at home, ascribed to the degradation and ruin of the ancient gentry and landholders, who had great authority and respect among the people, and who were universally looked up to as the guardians of civil order. On this subject, Mr Stuart, judge in the Benares division, in a Report to Government, reasons with great force and clearness, and observes, that the extinction of the aristocracy "may be traced throughout the country as one principal source of the disorders which prevail." *(Fifth Report*, p. 574.) The great problem, therefore, in the government of India, is to devise the means of re-establishing, in the country, a body of resident gentry, qualified to undertake the management of its internal affairs; and for this purpose no policy seems so effectual as the encouragement of European settlers. If this policy were adopted,—if Englishmen were allowed to acquire land, and taught to consider India as their home, they or their descendants would gradually become naturalised to the climate,—they would be compelled to mix with the natives in their ordinary transactions, and the succeeding generation familiar with the language, manners, and character of the natives, might be qualified for the important duties which are now so inadequately discharged. At present the government of India is composed of a small body of foreigners, who have no interest in the welfare of the country, and who only visit it for the purpose of engrossing, from their rightful owners, every post of honour or profit. It is a strange, anomalous, and insolent domination of the few over the many; it has no tie of sympathy to connect it with the people; it draws no support from the natural feelings and affections of mankind, but derives its strength mainly from the knowledge of its power. It is a singular spectacle to see a whole people, through the agency of foreigners, excluded from all honourable competition for public rewards. A proscription so universal must produce the most unfavourable effects on the national character. By narrowing the sphere of ambition, we diminish the incentives to active exertion—we take away from mankind the motives which prompt them to cultivate their faculties—we weaken the animating principle of all improvement—we relax the moral tone of society, and thus pave the way for the progress of vice and disorder. All accounts accordingly agree that the state of morals in Hindostan has not been improved under the rule of the English. "The decline of morality," says Lord Moira, in his judicial minute, dated 2d October 1815, "is stated to be a subject of reproach against us by all the natives whom birth or education have inspired

with concern for the good order or well-being of society." This is imputed to the decay of religious endowments and public seminaries; and to the decline, also, of those moral sanctions connected with custom, religion, and prejudice, which have been gradually relaxed under the ascendancy of the British law. But the monopoly of power, emolument, and honour, in the hands of a few, by constituting the majority a degraded class, must have also had its share in producing those unfavourable effects on the character of the people. Mr Stuart (already alluded to, whose Reports on the state of India abound in the most masterly views of the state of property and manners,) expresses this opinion in the strongest terms: "As we proceed (he observes), these provinces will soon present the singular spectacle of a great empire, the government of which rigidly excludes its subjects from every object of fair ambition, which, in the pursuit, could stimulate men to cultivate their faculties, or, in the possession, enlarge their understandings and elevate their minds. The natives may accumulate wealth as merchants, they may be proprietors of land; but these occupations, as they are managed in this country, have no great tendency to raise the character. Beyond them, with the rarest exception, there is nothing to which the people can aspire, higher than the command of a platoon of seapoys, or the possession of some petty civil office, insignificant in its functions and paid with a salary hardly adequate to a bare subsistence. My speculations may have perhaps misled me, but I am persuaded that very unfavourable effects from these causes, may already be traced, in the habits of our native subjects, and their long continuance must, I think, infallibly end in reducing the whole population to one ignorant, grovelling, litigious, and profligate herd."

The Directors of the Company in Europe, as soon as they were informed of these vices and disorders in their Indian government, displayed the most praiseworthy zeal in their endeavours to remove them. Far from blaming the freedom with which they were exposed, or seeking, by palliations, to evade the truth, they listened to the representations of their servants, and, in many cases, followed their judicious and enlightened suggestions. One of their first cares was to re-establish the vigour and efficiency of the police. It was soon found that the system established in 1793, not being connected in any degree with the institutions or local manners of the country, was ill adapted to its end; and that the subversion of the ancient establishments, on the ruin of which it was founded, had been attended with the worst effects, and had paved the way for all the disorders and evils with which the country had been afflicted. To restore the ancient institutions of the country is now, therefore, the policy of the government; and, for this purpose, they are endeavouring to revive, for the public service, the ancient array of village watchmen and zemindary constables, formerly disbanded. In many cases, their efforts have been attended with success. A new energy has been infused into the police; and this, joined to the activity of the local magistrates, has had the effect of diminishing the crime of gang-robbery; though, in some districts, this crime still prevails, and continues to spread dismay through the peaceful country. It does not appear that there has been any decrease of other offences, or that the morals of the people have been in any degree improved. This desirable effect, indeed, if it takes place, must be the work of time; and a long period must elapse before, even under the best institutions, the effect of former errors can be done away. For the improvement of the people, the village schoolmasters have been everywhere encouraged; and, for the same laudable purpose, other seminaries are about to be instituted. The civil courts, according to recent accounts, still continue to be overloaded with an arrear of undecided causes. To remedy this defect, assistant judges have been appointed; and it has been proposed to have recourse to the effectual assistance of the natives in the judicial business of the country. Those judicious arrangements, aided by the zeal of the Directors at home, and by the great ability employed in the local government, may certainly check those alarming disorders by which the country has been distracted. But the evils which afflict the Indian community have continued too long, and are now too deeply rooted, to be easily removed.

Recent History.

Nepaulese War.

From the year 1805, when a general peace was established by Lord Cornwallis, to the year 1813, when Marquis Hastings assumed the government, the political relations of the Company with the native powers had undergone little alteration. The tranquillity which prevailed was, however, more apparent than real; and it was scarcely to be supposed, indeed, that the widely extending domination of a foreign power could long continue to be viewed without jealousy by the native princes of India. Such of them, accordingly, as retained any sense of national honour, were naturally hostile to the British, and were well disposed to unite against them as the common enemies of Indian independence. In 1814 the war with the Nepaulese commenced, and in the outset the reverses sustained by the British in their attempts to penetrate into the hill country, strongly excited the hopes of the native princes. In the following year, the valour and military talents of Sir D. Ochterlony, brought that war to a brilliant close; and the bravery and discipline displayed by the troops in the course of the campaign, renewed among the Indian princes the former impression of their invincible superiority. Whatever might be their ulterior views, therefore, they were compelled for the present to temporize, and to soothe their conquerors by an outward show of humility and peace.

War with the Pindarees.

A more favourable opportunity, as they conceived, soon occurred for successful resistance to the British power. From the constant wars and commotions in which India had from time immemorial been involved, it happened that a great proportion of the native population were trained to habits of disorder and military licence. At the general settlement concluded in 1805, it was naturally supposed that these bands of adventurers, having no longer any scope for their predatory enterprises, would betake themselves to pacific pursuits, and would thus be gradually dissolved among the mass of the people. It happened otherwise. Those hordes of freebooters, known under the general denomination of Pindarees, im-

proved both in strength and union, and Scindia and Holkar, in whose neighbourhood they were settled, if they did not openly abet them, made no active efforts for their suppression. The nature of their force may be shortly described. It consists of a species of light cavalry, which was formerly attached to the native armies, in the same manner, and for the same purpose, as the Cossacks are to the armies of Russia. Their horses were trained to long marches and hard fare, it being their object to plunder the country, and to elude pursuit by the celerity of their movements. They were generally armed with a bamboo spear, from 12 to 18 feet long; every fifteenth man carried a matchlock; about 400 out of every 1000 were well mounted; of the remaining 600, 400 were indifferently mounted, and the rest were slaves, attendants, and camp-followers, mounted on wild ponies, and keeping up with the corps as they best could. About the year 1814, these predatory bands comprised about 40,000 horse, who followed plunder as their mode of subsistence, and were indeed a more formidable species of gang-robbers; but, like other robbers and murderers on a great scale, they assumed all the form and pomp of military array. The strength and numbers of this disorderly mass were daily increasing by deserters from Holkar's irregular bands, and from the loose cavalry establishments of Scindia and others, where they were retained by no tie but that of present advantage, and where their pay was always in arrear. The central situation of the Pindarees, at an equal distance from the three presidencies, rendered their hostility still more formidable, and enforced on the British the necessity of maintaining an extensive line of defence, which was always, however, penetrated by those flying hordes, and the territories of our allies exposed, in consequence, to annual devastations. In 1808-9, and in 1812, they carried their incursions into the British territories, and returned loaded with spoil. The fame of these successful exploits recruited their bands, and enabled them to extend their ravages. In October 1815, a force of 8000 Pindarees crossed the Nerbuddah in a north-west direction, and, dividing into two parties, they penetrated to the Kishna, though they were watched, and one party was surprised by a body of infantry and cavalry, which did them, however, little damage. They were only deterred from crossing into the Madras presidency by the swollen state of the river, along the fertile and populous banks of which they took their course, plundering as they went along, and committing every kind of enormity. In their return along the line of the Godavery and the Warda, they passed the British positions, making good their retreat with an immense booty, and with utter impunity. A second expedition was soon planned, which, crossing the Nerbuddah, appeared on the western frontier of the district of Masulipatam, under the Madras presidency, on the 10th of March 1816. Next day they made a march of thirty-eight miles southward, plundering ninety-two villages, with every circumstance of unheard of cruelty, and, on the 12th, they marched thirty-eight miles, plundering fifty-four villages. By the 17th May they had nearly all recrossed the Nerbuddah, loaded with spoil, and with scarcely any loss. During the twelve days that they had remained within the Company's territories, it was ascertained that 182 persons had been put to a cruel death, 505 were found severely wounded, and 3603 had been put to different kinds of torture.*

It now became necessary to adopt efficient means for protecting the country against these destructive visitations. For this purpose, a defensive line of posts was extended along the Nerbuddah, and across the country for about 150 miles. This was, as usual, soon penetrated by the activity of the enemy, and various expeditions advanced southward for the purpose of plunder. By the singular activity of the different corps, and by a train also of fortunate accidents, almost all of these expeditions were intercepted, broken, and discomfited, so that very few of the plunderers made good their retreat. It was resolved, however, in the year 1817, to commence offensive operations—to attack the enemy in their native haunts, and either to exterminate them, or to drive them from the advantageous position which they occupied, in the very centre of India. The season of inaction was accordingly spent in making preparations for a great military effort; and, by the end of the rainy season of 1817, a numerous and well-appointed army was ready for the field. The plan of the campaign was, that the armies of the different presidencies should advance southward, and gradually converging to a common centre, hem in, on every side, the devoted territory of the freebooters.

But, while this plan was in progress, it was interrupted, and part of the troops engaged in executing it were suddenly recalled, by the unexpected hostility of the native powers. Bajee Rao, the Peshwa, or Prince of Poonah, who had long been impatient of the British yoke, availed himself of this opportunity to make a fresh attempt at independence. With a view of more vigorously prosecuting the war against the Pindarees, all the troops had moved southward, with the exception of a brigade which had been left at Poonah; and it was to overpower this small body of troops that the Peshwa's first efforts were directed. They were completely unsuccessful, however; he was repulsed at all points, by the steadiness of the Company's troops. This action took place on the 5th November. On the 13th, the British were joined by General Smith's division, which had advanced on the Godavery, on an understanding that, if he did not hear daily from the resident at Poonah, he should countermarch to that place. It was resolved to attack the enemy's camp next day, but it was found deserted. General Smith immediately commenced an unremitting pursuit of the Peshwa, who was hunted from place to place by the different corps of the British army, until he at length deemed it prudent to surrender. He was deposed from

* *Narrative of the Political and Military Transactions of British India under the Administration of the Marquess of Hastings.* By Henry T. Prinsep, Chap. i. and v.

his throne—a residence in a particular city was fixed upon for him; and a pension of about L.100,000 *per annum* assigned him for his support. His dominions were, of course, taken under the administration of the British.

The Rajah of Nagpoor, Appa Saheb, who was held in the same thraldom by the British, pursued a similar course, and with the same results. On the 26th November, at sunset, he attacked, with a great superiority of force, the brigade left at the residency, which was, in consequence, in great peril. A doubtful contest was maintained through the night, and next day the attack on the British was renewed with fresh vigour. Under every disadvantage, however, these attacks were finally repulsed, and the weak prince, Appa Saheb, taking fright, sent to ask forgiveness from his enemies. The conditions offered him were, that his territories should be placed at the mercy of the British government—that he should give up all his artillery, disband his troops, and come in person as a hostage into the British camp; on an understanding, however, that if he acceded to these terms, the former relations between him and the British would be restored; it being at the same time understood, that he should cede part of his territory, and that due provision should be made for a greater degree of internal control over his future movements. Being threatened with an immediate attack, he came to the British camp with a few attendants. His troops, however, as if to shame their pusillanimous prince, fought an unsuccessful battle for his rights and independence; after which, the city of Nagpoor, with its fort, was surrendered to the conquerors, and this second war brought to a triumphant close. Appa Saheb, afterwards repenting of his spiritless conduct, began to plot new schemes; when he was arrested by the British resident, and detained in close confinement. He found means to escape in the summer of the following year, and making good his retreat to the hills, where, being joined by a band of irregular followers, he continued to give disturbance up to the latest accounts.

It had been the professed intention of the Anglo-Indian government, according to its usual arbitrary mode of treating the native powers, to force the two independent chiefs, Scindia and Holkar, into an acquiescence with its views in regard to the Pindarees, and also the Patans, a species of infantry, better appointed, and more regularly disciplined, than the Pindarees, but associated together on the same unlawful principle of indiscriminate plunder. Scindia had been compelled to temporize, and finally to accede to the British propositions; Holkar, feeling strongly the disgrace of yielding to foreign threats, resolved to try the fortune of war. A battle took place on the 21st December, in which he was totally defeated, with the loss of his camp and all his artillery. He sought peace, which was granted him, but he was compelled to accept of British protection and alliance, which has always been accounted the last dishonour of an Indian prince.

Destruction of the Pindarees.

The main object of the war, which was the destruction of the Pindarees, was not, in any material degree, impeded by those incidental contests. According to the plan proposed, the different divisions of the grand army proceeded southward, converging as they advanced for the purpose of surrounding their haunts, and preventing their escape. They were driven out of the province of Malwa, retiring as the British advanced, but were at length so effectually hemmed in, that, in attempting to retreat, they were intercepted at all points, and the greater part of them destroyed. The remainder were so humbled by fatigue and misery, that they were glad to submit on any terms, and at length the three chief leaders surrendered on condition that their lives should be spared.

General Review of the Company's Government and Affairs, considered in [illegible] to [illegible]

It will now be proper briefly to revert to the commercial character of the East India Company, and to inquire what has been the general result of its transactions, considered merely with a view to *profit and loss*. So long as the attention of the Company was confined merely to trade, the annual dividend which, from the year 1708 to 176[illegible], varied from 5 to 10 *per cent.* may be taken as a tolerably fair criterion of the profit gained. The acquisition, in 1765 of the sovereignty and revenues of Bengal gave rise among the proprietors to the most extravagant anticipations of wealth, and, on the faith of these, the dividend, as already mentioned, was raised to 10 and afterwards to 12 *per cent.* These expectations proving fallacious, it was, in 1773, lowered to 6 *per cent.* It was afterwards raised to 8, and, in 179[illegible], to 10½ *per cent.* Ever since the acquisition of the sovereignty of Bengal, it was not so much from *trade* as from *revenue* that the Company's profits were expected to arise. It was by the remittance of a large surplus revenue from India, that the proprietors hoped to be enriched. These hopes, however, have never been fulfilled. A large and increasing revenue has been indeed collected; but it has been invariably followed by an increase of charge; and the debt in India, which began in 1760, has been gradually increased to the enormous sum of L.[illegible], its amount in April 1818.

The constant increase of the charge is a standing subject of complaint in the correspondence of the Directors with their servants in India, whom they frequently accuse of the grossest profusion and corruption, reproaching them with the enormous expense of their establishment, and urging them, in the most earnest manner, to retrenchments and economy, while the servants, on the other hand, always hold out the earnest promises of their future management, and flattering statements of revenue to be regularly overturned by the increasing charges of the succeeding year.

When Lord Clive was sent out to India in 1765, it was for the purpose of securing the Company's revenue from the profusion and mismanagement of corrupt servants, against whom the clamour in this country was loud and general. No amendment, however, took place, and the Directors continued their complaints. During the ten years' administration of Mr Hastings, which commenced in 1772 and ended in 1785, the Company were deeply involved in the wars and politics of India, the effect of which, on the finances, appears to have been to increase both the revenue and the charge, and in the same proportion to accumulate debt. In 1772 the revenues of Bengal, Bahar, and Orissa, amounted to L.2,373,650, the charges to L.1,705,[illegible]; produ-

cing a surplus of L.668,371. The India debt amounted to L.1,850,166. In 1785 the revenues of Bengal, Bahar, and Orissa, including the new revenue of Benares, amounted to L.5,315,197; the charges to L.4,312,519; thus producing a surplus of L.1,002,678; to counterbalance which, however, the debt in India was increased to L.10,464,955. With the management of their affairs in India, the Directors never seem to have been satisfied; for we find them about this period complaining that certain late revenue regulations were made, "rather with a view of creating lucrative posts for a certain description of men, than with any design either of increasing the revenue, or of promoting commerce." In the same strain we find them complaining in a letter to Lord Cornwallis of a disposition in their servants to "innovation and experiment, without urgent necessity, or apparent cause, new institutions, and almost instant deviations from them, multiplication of offices, and increase of salaries." These, they continue, "are always introduced with flattering schemes of increase to the revenue and diminution of expense, which has hardly, in any instance, been realized by the event." In consequence of this constant increase of expence, though the Company's revenues were increased, the surplus revenue was diminished. In the same letter, the Directors state, that it was one million less than in 1766, when the Bengal revenues were acquired.

In 1793 the revenues amounted to L.8,225,628; the expence to L.7,007,050, thus yielding a surplus of L.1,218.578; and the debt was reduced to L.7,971,665. This state of the Company's affairs became the subject of the most extravagant declamations both in Parliament and elsewhere. The old delusion of Indian wealth, nearly as absurd as the South Sea bubble, was successfully revived; annual remittances of treasure were confidently expected and confidently promised; and the expected surplus was most gravely appropriated by acts of Parliament to its appointed ends. Mr Dundas was the principal actor in this solemn farce, in which, being probably credulous himself, he imposed on the credulity of others, boasting that India would be a vast source of wealth to the Company, and to the nation. These predictions were soon falsified by the event. The surplus of Indian revenue, for the appropriation of which so many wise provisions were passed, soon vanished, and in 1797, a deficiency appeared which continued till 1810. The revenues had, in the meantime, increased from L.8,225,628, their amount, in 1797, to about 15½ millions sterling; but in place of any surplus being remitted from India to Europe, there appears a balance against India, from 1797 to 1807, to the amount of L.1,629,701; and it appears, that, during this period, there was sent from England to India, more than was received, a sum of L.5,691,689. This was the sum, therefore, which England lost during these ten years, by its connection with India. From another account also it appears that, from 1793 to 1816, England remitted of cash to India L.8,824,067 more than was received. (See *East India Annual Accounts laid before Parliament*, p. 19.) In 1811, the revenues began again to exceed the charges; and, in the three following years, there was a large surplus of nearly three millions Sterling in each year. In 1816, 1817, 1818, this surplus continued to be above two millions annually; and it is stated by Mr Prinsep, in his narrative of the last Indian war,* that there was actually accumulated in the different treasuries of the Company bullion to the amount of eight millions Sterling. Here, then, was an opportunity for making a great remittance to the Directors in Europe. But of this large accumulation of treasure they received not one shilling. The Indian government was involved in a series of new wars, in the carrying on of which not only was all this wealth expended, but an additional sum of about 4½ millions Sterling was borrowed; so that the Indian debt, which in 1814 amounted to about 29 millions Sterling, was raised to nearly L.34,775,792, its amount in April 1818. Mr Prinsep, however, in his interesting account of the administration of Marquis Hastings, still confidently holds out the hope of a surplus revenue; and he founds his expectations, 1st, On a reduction of expence, in consequence of the peace recently concluded; and 2dly, On a great increase of revenue from the late extension of the Company's territories. It remains to be seen how far these expectations will be fulfilled.

A general view of the Company's affairs discloses similar results. In 1772, after the possession of the Bengal revenues should have produced its full effect, the Company was involved in such difficulties that, on an estimate for three months of the payments falling due, and of the funds for their discharge, there appeared a deficiency of above L.1,200,000. At this time the Company was assisted with a loan of L.400,000, and afterwards of L.200,000 from the bank, and with L.1,400,000 from government. In 1773, from a general account of the Company's affairs, it appeared that their effects and credits in England, set against their debts, produced an unfavourable balance of L.1,431,424, 19s. 8d. The same account of their effects and credits in India, set against their debts, produced a favourable balance of L.4,364,993, 10s. 10d. Deducting the one from the other, the remainder, consisting of their whole available property, amounts to L.2,930,568, 10s. 10d. which is all, therefore, that remained of their original capital, amounting to L.4,200,000. According to a general account of the concern in 1793, this favourable balance was reduced to L.1,956,866, less than in 1772 by L.973,702, and to this we have to add an additional million of capital subscribed in 1789, at 174 *per cent.*, amounting to L.1,740,000; thus showing a deterioration of the Company's affairs, from 1772 to 1793, to the amount of L.2,713,702. In 1810, the same general account showed a balance against the Company of L.6,025,505; to which the Committee of the House of Commons, appointed at that time to inquire into their affairs, having added the capital stock received

* Mr Prinsep has not told us on what authority this statement rests.

in 1793 and 1794, and made several other adjustments, there appeared a balance against the Company of L.11,062,591, which they had no effects to discharge. In 1813, this unfavourable balance had increased to L.7,773,493; but in 1815, the Company's affairs were so far improved that it was reduced to L.2,611,311. Adding the capital received, amounting to L.7,780,000, the balance against the Company appears, at this period, to be L.10,391,311.

Renewal of the Company's Charter, and partial opening of the Trade.

Although, at each successive renewal of the Company's charter, the mercantile part of the community have remonstrated against the continued monopoly of the Indian trade, it was not till the year 1814 that this trade was in any degree laid open to the merchants of this country. This was effected by the act passed in 1813, which, with the exception of the trade in tea, and the China trade, opened the general commerce of India to the merchants of this country, under certain limitations and restrictions. The Company was as tenacious as ever of their valued monopoly; they gave it up only when they found they could no longer retain it; and they still contrived to narrow, as much as possible, the freedom granted, by unfavourable restrictions. The trade with China, and the important trade in tea, was still continued under a strict monopoly: and, as a security against apprehended dangers to their dominion, from an unrestricted trade, it was provided, that no vessel engaged in the private trade to India should be under 350 tons burden; that no vessel should proceed to any place on the continent of Asia, between the Indus and Malacca, without a special licence from the Directors, regulated by the Board of Control, nor to any place not on the continent of India, within the same limits without a special licence. The effect of these restrictions is greatly unfavourable to the extension of the Indian trade; as they exclude the British merchant from the eastern coast of Africa, from the Red Sea, the Persian Gulf, all the numerous islands scattered in the Indian Ocean, and all other countries eastward of Malacca; with which the Americans and others, who are freed from these restrictions, carry on an extensive and lucrative trade. The rigid monopoly still held by the Company of the Chinese trade and the trade in tea, is severely felt by the British merchant; the effect of it being to exclude him from a most beneficial branch of commerce, engrossed, not by the Company, but by foreigners. The trade between China and Europe, in which tea, the great staple of the one, is exchanged for the manufactured products of the other, is chiefly carried on by the Americans, for whose benefit, therefore, and not for the benefit of the Company, the British adventurer is excluded from this trade. Such further relaxation of the Company's monopoly is, therefore, still anxiously sought for by the merchants of this country, as would allow them to enter into such branches of commerce as are at present entirely engrossed by foreign merchants; and these demands are so just and reasonable, that, on every principle, they ought to be conceded. It is doubtful, however, whether the Company will agree to soften, in the smallest degree, the harsh provisions of their pernicious monopoly.

The Private Trade.

Under all the restrictions imposed on it, however, and under all the difficulties incident to new undertakings, the private trade to India has increased to such a degree, that the shipping employed in it during the last six years has nearly tripled the amount of the tonnage in the service of the East India Company. The extent of the trade carried on in private vessels has also been gradually increasing, until it now regularly exceeds that of the Company, although the private merchant is still excluded from the trade to China, and from the tea trade. The value of the tea, exclusively imported into Great Britain by the Company, generally exceeds three millions Sterling. During the two years, 1818 and 1819, it amounted in each year to L.3,062,734, and to L.3,645,078. Still, however, with little more than L.200,000 for this article in the list of private imports, the value of the latter exceeded that of the Company's imports in 1818 by L.4,905,846, and in 1819 by L.595,115. The following account will show the progressive improvement of the private trade:—*

Years.	Value of Exports by the Company, year ending January 5,	Free Trade including Privilege Trade.	Value of Imports by the Company, year ending January 5,	Free Trade including Privilege Trade.
	L.	L.	L.	L.
1815,	1,732,719	870,177	7,227,06[illegible]	4,061,892
1816,	1,752,30[illegible]	1,454,728	7,154,130	5,769,459
1817,	1,559,13[illegible]	1,868,39[illegible]	7,855,312	5,703,912
1818,	1,313,49[illegible]	2,708,024	7,361,802	5,097,748
1819,	1,250,061	3,052,741	5,192,804	7,098,650
1820,	1,358,52[illegible]	1,650,[illegible]	5,792,405	6,297,519

This account proves sufficiently what an important advantage would be conferred on Great Britain by setting free the commerce of India from the restraints imposed on it. The use of British manufactures is daily becoming more common, and there is no doubt that if more scope and facilities were afforded to the free trade, it would soon become beneficial and lucrative. And when we consider the commercial embarrassments under which the country has been long labouring, it seems but reasonable that every possible expedient should be adopted for the revival of its depressed commerce, and that, if the grievance of the Company's unjust monopoly cannot be entirely done away, the mischief should still be confined within the narrowest limits possible.

The article BENGAL, in the *Encyclopædia*, contains an account of that province. The article HINDOOS contains an account of the manners, religion, arts, and learning of the people of India. The article HINDOSTAN, contains a geographical view of India, and narrates its earlier history; while the history of its more recent wars, and revolutions, down to the conclusion of the Mahratta war, under Marquis Wellesley, is given under the article INDIA. (o.)

* See *Papers ordered to be printed by the House of Commons*, 1819.

Ingenhousz.

INGENHOUSZ (John), an eminent physician and natural philosopher, was born at Breda in 1730. He was first established in medical practice there, but removed to London in 1767, particularly with a view to study the improved methods of inoculation then lately introduced. Having become acquainted with Sir John Pringle, at that time President of the Royal Society, he was by him recommended to the Austrian ambassador, for the purpose of inoculating the Imperial family at Vienna, the Empress Maria Theresa having lost two of her children by the natural small-pox. He accepted this engagement in 1768, and having been perfectly successful in his operations, he was remunerated by the grant of a pension of L.600 a year for life, together with the titles of Aulic Counsellor and Physician to the Imperial Family. He was also consulted, in his medical capacity, by many others of the most distinguished personages at Vienna, and he enjoyed the particular esteem of the Emperor Joseph II. who was fond of receiving him in his cabinet, and of witnessing the exhibition of a variety of physical experiments, with which it was always the delight of Ingenhousz to amuse and instruct his acquaintance of both sexes. The following spring he went to Italy, and inoculated the Grand Duke of Tuscany. He was made a Fellow of the Royal Society in May 1769; but he appears to have remained some years in Italy; for he was at Leghorn in January 1773; in March he dates from Salzburg; and in November 1775 from Vienna. The next year he was in London; and, in the winter of 1779, he went to Paris. The latter part of his life he spent principally in England, which, notwithstanding his dislike to the chilliness of the climate, was always his favourite residence, and "where he enjoyed during many years," to use his own words, "that felicity which a free and independent man finds in the pursuit of knowledge and wisdom, in the society and friendly intercourse of those who have distinguished themselves by their learning."

Dr Ingenhousz was cheerful in his disposition, and often playful in his conversation. Though his pursuits were chiefly scientific, he was not destitute of taste for literature and poetry. He had a particular predilection for Lucan, and for the Cardinal de Polignac, and would frequently recite passages from their poems with great energy, and with a strong German accent. Nor did he disdain the comforts of commercial opulence, and he was often a visitor at the magnificent villa of the late Mr Rucker of Rohampton. He had been introduced there by his friend Dr Brocklesby, who was in many respects of a perfectly congenial disposition, and who had great pleasure in prevailing on him to partake occasionally of his own hospitality, when his table would otherwise have been solitary. He died the 7th September 1799, at Bow Wood, in Wiltshire, the house of the Marquis of Lansdown, who had long known and esteemed him.

Dr Ingenhousz's principal publications are, 1. *Experiments on the Torpedo. Phil. Trans.* 1775, p. 1. Mr Walsh had lately gained considerable reputation by his account of the effects of the torpedo. These experiments, which were made off Leghorn, in company with Dr Drummond, are merely illustrative of the properties of that animal, which are now better known; and they afford no decided test of the electrical nature of the phenomena.

Ingenhousz.

2. *Methods of Measuring the Bulk of Mixtures of Common Air, and Nitrous Air, with Experiments on Platina, Phil. Trans.* 1776, p. 257. The eudiometrical apparatus is described as an improvement on Fontana's. The experiments are intended to show that platina is not an alloy of iron and gold, since it may be deprived of all magnetic properties by repeated cupellation.

3. *A Way of Lighting a Candle by an Electrical Spark. Phil. Trans.* 1778, p. 1022. A very small charged jar setting fire to pulverised resin, strewed on cotton.

4. *On the Electrophorus*, p. 1027. This is a Bakerian lecture, read by appointment of the President and Council of the Royal Society, relating to the instrument then lately invented by Professor Volta, and which had been made known to the author by the Archduke Ferdinand. Its action is explained upon the elementary principles of the Franklinian theory. The next article in the volume contains some experiments of Mr Henly in confirmation of the doctrines here advanced.

5. *On a New Inflammable Gas. Phil. Trans* 1779, p. 376. A powerful explosion is produced by the detonation of the vapour of a single drop of ether with oxygen gas. The author takes occasion to investigate the elasticity of the gas evolved by the detonation of gunpowder; and agrees with Bernoulli in estimating it as equivalent to near 2500 atmospheres. It may here be remarked, that notwithstanding Bernoulli's general accuracy, and great mathematical talents, he has fallen into a very singular error, in comparing the force of gunpowder with the daily labour of men; and has accidentally made the force of one pound equivalent to the daily work of 100 men, while, in fact, the force of 40 pounds is only equivalent to the daily labour of a single man.

6. *On a mode of Suspending Magnetical Needles*, p. 537. Proposing that a hollow needle should be immersed in linseed oil, so as to press with a small portion of its weight only on its axis, in order that the friction may be greatly diminished.

7. *Improvements in Electricity*, p. 661. On plate machines of glass and pasteboard, and on a ribbon machine. A Bakerian lecture.

8. *Experiments on Vegetables.* 8. Lond. 1779. This volume is chiefly occupied by the detailed proofs of the author's principal discovery, that vegetables in general pour out a portion of oxygen gas in the sunshine, while they rather diminish its proportion at night and in the shade. It is dedicated to Sir John Pringle, and was translated into *French* by the author. 8. Paris, 1786. Second edition, 2 vols. 8vo. 1787-9. *Latin by Scherer.* Vienna, 1786. *Dutch by Dr Van Breda*, of Delft, with others of his works.

9. *On the Salubrity of the Air at Sea, and at Places far removed from the Sea. Phil. Trans.* 1780, p. 354. From the imperfection of the test employed, it was easy to imagine that some differences were discovered, which subsequent observations have shown to have no existence.

10. *Nouvelles Expériences et Observations*, 2 vols. 8vo. Paris. On different subjects of natural philosophy. In German by *Molitor, Vermischte Schriften*. Vienna, 1784.

11. *On the Influence of the Vegetable Kingdom in the Animal Creation. Phil. Trans.* 1782, p. 426. Asserting the accuracy of his experiments, and denying some statements of Dr Priestley; advancing, in particular, many arguments to prove that the air obtained is really supplied by the vegetables, and not by the water in which they are usually immersed, in order to collect it. Dr Ingenhousz was, on all occasions, anxious to support his claim to this very interesting discovery; and he insisted that Priestley's earlier experiments, on the green matter contained in stagnant water, had little or nothing in common with his own, because that matter was, in fact, of an animal nature. He was in the habit of collecting the gas from cabbage leaves, and of keeping it bottled up in his pocket: and he was prepared with some coils of iron wire fastened into the corks, in order to exhibit the brilliant phenomenon of their combustion to his friends: the public being at that time less accustomed to this dazzling exhibition, than it has become in later years, when elementary lectures on chemistry have been more commonly addressed to mixed audiences than heretofore.

12. *Essay on the Food of Plants*, 8vo. Lond. 1798 From the French.

13. Dr Ingenhousz also inserted some essays in different volumes of the *Journal de Physique*; but they possess less originality and importance than his English publications.

(Chalmers's *Biographical Dictionary*, XIX. 8vo. Lond. 1815—Kesteloot, in *Biographie Universelle*, XXI. 8vo. Paris, 1818.) (U. N.)

INSECTA.

The animals which Linnæus included in his class Insecta have been distributed into four classes by modern naturalists. These are termed, Crustacea, Myriapoda, Arachnides, and Insecta. The distinguishing character of these different groups have already been laid before our readers under the article Annulosa, in which the systematical divisions of the three first have been pretty fully illustrated. In regard to *insects*, a reference was there made to the present article In the fulfilment of our plan, we shall now take a view of the structure and physiology of insects; their classification, and the methods of preserving them for the cabinet, which are now in use.

The attention of naturalists, in general, has been confined to an examination of the forms of insects and the number of their parts. Their internal structure has been in a great measure overlooked, and little accurate information is known concerning many of their functions The task, indeed, of examining the anatomy of insects is one of peculiar difficulty. The organs, in many cases, are complicated in their structure, and limited in size, so that in dissecting them, the point of a needle must frequently be employed instead of a scalpel, and the eye requires the assistance of high magnifiers. There are few, therefore, who have prosecuted this department of the subject with zeal or success, and who have inspired others with confidence in the accuracy of their statements. Swammerdam and Lyonet, however, form illustrious exceptions.

Plan of this Article

In the observations which we propose to lay before our readers in this article, we will confine ourselves, in the *first place*, to a brief exposition of the anatomy and physiology of insects, as the statements are given in considerable detail in the *Encyclopædia*, under the article Entomology. It was necessary, however, to advert again to the same subject, for the purpose of noticing some of the recent discoveries which have been made by modern naturalists. In the *second part* of the article, there will be given an abridged view of the modern method of classifying insects In the illustration of the first part of the subject, we shall begin by considering,

I.—*The Organs of Protection and Motion.*

The skin of insects serves the double purpose of protection and support, and represents the cutaneous and osseous systems of the vertebral animals. Its structure appears much more simple than in the higher classes, as it can neither be said to possess a mucous or cellular web or true skin. It bears the nearest resemblance to the cuticle of the skin of the higher classes, or rather, all the laminæ of perfect skins are here incorporated into one uniform plate It exhibits very remarkable varieties of texture. In some insects, as the house-fly, it is soft and pliable, while in others, as some of the weevils, it approaches the consistence of bone. In some species it is elastic, in others brittle.

The appendices of the skin consist of spines, hairs, and scales. The spines are merely projecting portions of its substance, and are usually distributed over certain parts of the feet, to aid the locomotive powers. Hairs are often distributed over the whole body; and, while they pass into spines on the one hand, they become, on the other, so exceedingly fine as to require the aid of a powerful magnifier to trace their character. These spines and hairs, being merely elongations of the skin, are not easily rubbed off. It is otherwise with scales. Some of these are inserted into their skin at their proximal, and are free at their distal extremity, and are so feebly connected, as to fall off, in many species, by touching them with the finger. These scales, in the butterfly, bear a remote resemblance to feathers in their form, and are very extensively used as pleasing objects for the microscope.

The Muscles of insects appear to possess the same internal structure as the same organs in the

higher classes. They are nearly all simple, and more or less transparent and whitish. All those which are concerned in the production of locomotion have their origin and insertion in the skin, apparently without the intervention of tendons. The different members appear to be connected with each other, by the intervention of a more transparent, tough substance, than the skin in other places, to which the name of ligament may be applied. The action of the muscles will be best understood by a description of the different parts of the body, and the motions which these perform.

1 The HEAD of insects contains the organs of the external senses and the mouth. It is joined to the trunk behind, and has its motions regulated by its mode of connection. Where the head is united to the trunk by a cylinder of ligament, the motion of which it is susceptible is various, limited chiefly in the dorsal direction by the superior margin of the trunk. When the articulation is effected by the immediate contact of the more solid surfaces, the three following modifications of joints present themselves. In the first, there are two or more rounded smooth tubercles, received into corresponding cavities in the trunk. The motion is consequently either backwards or forwards. In the second mode of articulation, the head is rounded posteriorly, and received into a socket in the thorax. In this manner great liberty of motion is obtained. In some cases, however, it is restrained by projections of the trunk, which limit it in one direction. In the third, the articulation takes place by the contact of two flat surfaces. The head is frequently contracted behind and the trunk in front, to diminish the uniting surfaces, but such joint admits but of very imperfect motion.

The muscles of the head take their rise near the abdominal edge of the trunk, and, entering the occipital hole, become attached to its margin. Those which move the head upwards take their rise on the upper part of the trunk; while those which depress it arise from the under side. These last are the largest. Those which arise from the lateral parts of the trunk, give to the head its lateral motions.

The characters derived from the head, which are used in classification, are chiefly taken from the markings of its surface, the inequalities of its margin, its size, and shape. They are, in general, obvious and permanent.

2. The TRUNK, as an organ of support to the other members, may be considered as the most important part of the body. The terms, however, which are employed to designate its different parts are neither appropriate nor well defined. Linnæus, in reference to this organ, gives the following enumeration of its parts: "Truncus, inter caput et abdomen, pedatus, thorace supra dorso, postice scutello, subtus pectore sternoque." By modern authors, it is usually divided into the thorax and breast.

The *Thorax* is the second ring of the body, and is united on the fore part with the head, and behind with the third ring or breast. In many species, this part is minute, while, in others, it occupies a large portion of the body. On its ventral aspect, it bears the fore legs, or first pair, and between these is the *thoracic sternum*, frequently in the form of a keel, and terminating behind by a spinous process, which rests upon the pectoral sternum, as in the genera Elater and Dytiscus. It may be considered as the only fixed part of the body, giving origin to the muscles of the head, the fore legs, and frequently, also, to the breast and abdomen.

The characters furnished by the thorax are extensively employed in the arrangement of insects. These are chiefly taken from its appearance on the back of the animal.

The *Breast* is frequently so much incorporated with the thorax, as to appear as one organ. In other cases, it seems to form a part of the abdomen. In the back, it frequently exhibits a horny process, termed *scutellum*, analogous in consistence to the thorax, to which it is united behind. At this place of the breast, the wings have their origin. On its ventral side, it supports the middle and hind legs. Between these, at the base, is the *pectoral sternum*, which, in some species, expands into a cover for the first joint of the hind legs, and in others is produced to cover a portion of the abdomen. The breast contains the muscles for moving the middle and hind legs, the wings and abdomen; and it likewise contains some very strong muscles, passing from its ventral to its dorsal surface, and calculated to bring these, when required, nearer together. This motion is probably facilitated by the number of sutures with which its skin is traversed. The characters for classification are chiefly taken from the scutellum and sternum.

3. The ABDOMEN is the last portion of the body of insects. In some species, it is sessile, and intimately united with the breast; in others it is divided by a stalk. It consists of rings, varying in number in different genera. These rings are joined together in many species by a simple adhesion of the margin, while, in others, the posterior margin of the one includes the anterior margin of the other. The motion of the whole abdomen takes place by means of muscles, which arise in the breast, and, in those where it is sessile, the motion is very limited. The rings themselves are likewise susceptible of a little motion, especially when they are included. The muscular fibres which change their position are longitudinal, and pass from the posterior margin of one joint to the anterior of the other, and are able to draw the ring to one side, or pull it within the one which immediately precedes it.

The classical characters derived from the abdomen are chiefly taken from the number of the rings, their connection, and the condition of their surface. At the termination of the abdomen, the anus and external orifice of generation are situated. These have frequently appendices, which we will afterwards notice.

4. The MEMBERS of insects are of two kinds, wings and feet.

The wings vary in their number, structure, and appendices. In one class, they are wanting, and hence termed Apterous; in another they are two in number, but the greater number have four. These wings are either membranaceous, and supported by

corneous ribs, which form a net-work in their substance; or, where the wings are four in number, the upper pair are sometimes crustaceous, obtain the name of *elytra*, and serve as a covering to the inferior ones. The ribs of the wings, improperly denominated nerves, in the manner of their distribution, the hairs by which they are covered, and the form of the vacant spaces, exhibit great regularity in the individuals of the same species. The manner in which the membranaceous wings are folded up, when at rest, is various. In some they are folded longitudinally, in others transversely, and in others obliquely. Each of these arrangements prevail throughout extensive groups. In the Diptera there is, under or behind each wing, a stalk terminating in a small knob. These are termed *halteres*, or *poizers*, and are considered as the rudiments of the second pair of wings. Between each poizer and the base of the wing, one or two spoon-like scales are found, termed winglets. They have likewise been observed in a coleopterous insect, *Dytiscus marginalis*. In some of the diptera they are absent. The use of these appendices of the wings has not been satisfactorily determined. The muscles which move the wings take their rise in the breast, and are capable of executing their functions with great celerity. The elytra perform no other motion than elevation and depression, and serve merely to protect the wings when at rest, not to assist them when flying.

The characters employed in the classification of the primary divisions of insects are, in a great measure, derived from the wings. Their presence or absence—their number and appendices—their texture and consistence, together with their size, position, and manner of folding up, yield marks which are of easy detection, and which experience has found to be permanent.

The *legs* of true insects are six in number. The first pair take their rise under the thorax, and the second and third pairs under the breast. They consist of the five following parts, the hip (*coxa*), the thigh (*femur*), the leg (*tibia*), the toe (*tarsus*), and the claw (*unguis*).

The *hip*, or coxa, serves to unite the limb with the body. It is usually short, or nearly as broad as it is long. It is imbedded in the thorax, or breast, and is limited in its motion by the mode of insertion. Sometimes its proximal extremity is globular, and received into a corresponding cavity of the body, giving to it a very extensive degree of motion. In other cases, the coxæ of the hind legs are consolidated with the breast.

The *thigh*, or femur, is usually united with the coxa, in such a manner as only to admit of motion backwards and forwards. At its coxal extremity, the femur has, in some tribes, one or two eminences, in some cases produced into spines, which are termed *trochanters*, and as they are hollow within, they are considered as furnishing suitable insertions to the muscles for particular motions. When the thigh is slender and cylindrical, the motion of the legs is confined to walking, but where leaping is required, or even swimming, the thigh is thick, and bellied, to give room to the requisite muscles.

The *leg*, or tibia, is articulated to the femur in such a manner as to admit of motion only in the same plane in which it moves. In those insects which swim, this joint is long and flattened, while, in those which dig holes in the ground, it is strong and serrated on the margin.

The *toe*, or tarsus, consists of several joints, which are articulated more loosely than the preceding parts of the limb, and admit not only of motion outwards and inwards, but likewise in a lateral direction. Its strongest muscle, as in the other parts of the leg, is the flexor. It is only by means of this part that the feet can apply closely to any object. The joints vary in number, length, and size; and, in many species, are furnished with very singular appendices. Those which deserve particular notice are denominated cushions and suckers, and are situated on the under surface of the joints. Accurate representations of these remarkable organs are given by Sir Everard Home, in the *Philosophical Transactions for the Year* 1816, (Plates XVIII.–XXI.), from the beautiful drawings of Mr. Bauer.

The *claw* (unguis) is attached to the distal edge of the last joint of the tarsus. In a few species it is single, or capable of being opposed to a projection, serving the purpose of a thumb. In others, the claws are double, and either move in the same plane, or act in opposition. The muscles of the different parts are all included in the limb, except those of the coxæ, which originate in the trunk. The former gives origin to those of the tibia, the latter to the first joint of the tarsus, and this again to the one which succeeds. These muscles are chiefly fixors and extensors, the former placed on the ventral, the latter on the dorsal surface of the limb.

From the enumeration which has now been given of the different organs calculated for the production of motion, we may see that insects are qualified for executing different kinds. Some, indeed, can only walk, others can walk and leap. Some can only walk and fly, others can walk, fly, and leap, while many can walk, fly, and swim, and, in addition, a few of these can leap.

II.—*The Organs of Sensation.*

The nervous system, in the class of animals now under consideration, exhibits a greater uniformity of structure and disposition than any of the other great systems of organs which they possess. The brain is situated in the head, on the dorsal surface of the gullet. It consists of two lobes, which exhibit slight variations of form, and are frequently so intimately united, that they appear as one, marked, however, in the middle by a groove. These lobes furnish the optic nerves, and frequently send filaments to the mouth. Near the posterior edge, two cords arise, which, after proceeding backwards, and, in many cases, embracing the gullet, unite to form a ganglion, from which nervous filaments proceed to the neighbouring parts. From this ganglion, two cords again proceed and form a second ganglion, and the same process is repeated until the cords reach the anal extremity, where they terminate. The number of ganglia which are formed, differ in different

general according to the number of articulations of the body. The cords, in some species, appear to unite and exhibit only the appearance of one.

The organs of the senses are more imperfectly developed in the insecta than in the crustacea. The eye alone is the most perfect of any of these; and next to it may be classed the organ of touch. The existence of the other senses common to the vertebral animals, is rather inferred from the actions performed than from the structure of their parts.

It would lead into too extensive details were we to give an account of the various instincts which insects exhibit, the knowledge which they possess of external objects, and the indications of memory and reasoning which their actions intimate. Many of these have been already communicated under the articles ANT and BEE, and to the reader who is desirous of more information on the subject, we would recommend *An Introduction to Entomology*, by Messrs. Kirby and Spence; two volumes of which have already appeared (1821), and the sequel is anxiously expected.

III.—*Organs of Nutrition.*

Under this division of our subject we include the alimentary canal, with all its appendices,—the vessels employed in circulation,—and those which are destined for aerating the blood.

1. ALIMENTARY CANAL. In treating of this important organ of nutrition in insects, it is necessary to begin with a description of the parts employed in obtaining and preparing food for the gullet. In many cases, as in the higher orders of animals, the legs, particularly the first pair, execute the first movement of seizing the food and conveying it to the mouth; in general, however, the parts of the mouth, unassisted, seize, cut, bruise, and prepare, the food for the gullet.

1. The *masticating* organs include the four following parts (which we shall designate by their Latin appellations, for want of appropriate English terms), labrum, mandibulæ, maxillæ, and labium. These form the mouth, and are denominated *Instrumenta cibaria.*

The *labrum* is analogous to the upper lip of the higher classes of animals. It is articulated to the fore part of the head (*frons*, or *clypeus*, *chaperon* of the French), either directly by a simple suture, or by the intervention of a plate, to which Kirby, from its situation, has given the name *nasus*. The labrum itself, at its free edge, exhibits great variety of character in the condition of its margin, of which entomologists have availed themselves in the discrimination of species. This organ may be regarded as the cover to the other parts of the mouth above.

The *mandibulæ* are two in number. They take their rise immediately below the labrum on each side. They exhibit very remarkable differences, in size, shape, and armature. They move horizontally, and serve to cut objects by their edges crossing like the blades of scissars.

The *maxillæ* are likewise two in number. They are united to the cheeks immediately underneath the mandibulæ, and between these organs and the labium. They are more complicated than the mandibulæ. On their inner margin they are usually covered with stiff hairs. Externally they support the *palpi*, which are articulated appendages, consisting of two or more joints. Each maxilla is furnished with one of these, rarely with two. The use of the palpi has not been determined, although it is probable that they serve as organs of smell, and perhaps also of touch.

The *labium* is analogous to the under lip, and closes the under side of the mouth, resting on the maxillæ. Its free edge is variously marked, and there is usually a line in the middle, indicating its tendency to be double. On each side it supports a palpus consisting of two or three joints. Its base is connected laterly by ligament, with the base of the maxillæ, and behind with a fixed plate jointed to the head, and termed *mentum*, corresponding, in position, with the nasus of the labrum.

When all these parts bear such a proportion to one another as to be able to cut the substances on which the insects feed, and convey them to the pharynx, they are considered as in the most perfect condition. But all these parts in the different classes exhibit very remarkable modifications. There are many species, which are destined to live chiefly or exclusively on fluid substances, to whom such masticating organs would be unsuitable. Those which hold a middle station between the gnawers and suckers, have the labium transformed into a soft fleshy plate like the tongue of quadrupeds (and hence frequently termed *lingua*), capable of licking, and of being rolled inwards when at rest,—as in the Hymenoptera, represented by the bee. In the genuine suckers, the organs of the mouth present two important modifications. In the first, the labrum is nearly obliterated; the labium is produced and either crustaceous (rostrum), or membranaceous (proboscis), with a groove on its upper side, for the reception of the four plates or hairs into which the two mandibulæ and maxillæ have been converted. These appearances are exhibited in the classes Hymiptera and Diptera. In the second, both the labrum and mandibles are nearly obliterated, and the labium is short and fixed; and the two maxillæ are produced and so applied to each other as to form a sucker. This sucker is capable of being rolled up spirally, and as it appears in the Lepidoptera, the butterfly for example, is usually termed the proboscis or tongue.

All these different parts of the mouth, however much they may be modified in size and shape, may still be readily detected, either by their position or palpial appendages. We owe this discovery of the true nature of the parts of the mouth of insects and the other pedate annulosa to M. Savigny, who has accompanied his judicious observations with accurate representations of each organ, and its various changes in the *Mémoires sur les Animaux sans Vertebros*, premier partie, Paris, 1816.

2. The orifice of the *gullet* is, in general, a simple aperture into which the food is conveyed chiefly by the agency of the maxillæ. In some cases, however, chiefly among the Hymenoptera, there is an organ on the base of the mouth, more or less distinct, to which the term *lingua* ought to be restricted. M. Savigny calls it glossa or hypopharynx. On the

dorsal margin of the opening there is likewise, in some cases, a particular process, which is denominated by the above naturalist *epiglossa*, or epipharynx.

The gullet itself is usually membranaceous, and is either simple or furnished with an enlargement, denominated the first stomach. In the true stomach the walls present the appearance of muscular fibres, and in some of the Orthoptera these bands cover the whole surface, forming a true gizzard, fortified with teeth or scales pointing backwards. The intestines are variously convoluted, and frequently, near the anus, exhibit an enlargement which has been denominated a rectum. In some cases the canal is furnished with one or more side pouches, or cœcæ, near the stomach.

The hepatic vessels (for there is no secreting organ which can be compared to a liver) have their origin in the fluid contents of the abdomen, and even send their capillary extremities to the remotest parts They vary greatly in number and size. The walls are dense and cellular, and the bile which they secrete is yellow, brown, or white, according to the species. These vessels, in some, terminate separately, in others they unite into a common duct The terminations vary greatly, being in different species at the pyloric extremity of the stomach, the middle of the intestine, or at the rectum.

In insects, neither absorbing nor circulating vessels have been detected, although anxiously looked for by many celebrated anatomists and microscopical observers. The nutritious portion of the food appears to be absorbed by the walls of the intestines, and discharged into the cavity of the body, where there are neither veins, arteries, nor heart. Towards the back, indeed, there is an obvious vessel, placed longitudinally, to which some have given the name of heart, but which is more generally denominated the *Dorsal Vessel*. This vessel is widest in the middle, and diminishes in size at each extremity. Its walls consist of two membranes, the internal one muscular, and the external one cellular. This last is so much crowded with tracheal vessels, as to appear to be entirely composed of them. All the coats are liberally provided with nervous filaments. This vessel is kept in its position by the tracheal tubes, and by muscular fibres, which, in general, are disposed in triangles, and increase in breadth from the superior part of the body to its inferior extremity.

The contents of the dorsal vessel are fluid, but of such consistence, that, when its coats are punctured, no liquid flows out. The colour is usually similar to the adipose matter which is collected on or near its surface, and differs according to the species. When placed under a microscope, this humour appears to consist of grains or globules, containing other globules. It mixes readily with water, and when dried, resembles gum.

The humour of the dorsal vessel is subject to some degree of motion, arising from the contractions which it experiences. These are irregular as to time, and proceed from the one extremity to the other, by stages usually corresponding with the rings of the animal, and strongest in the abdomen. The nerves do not appear to exercise any influence on these contractions. The muscular fibres and tracheal filaments appear to exercise the greatest control These contractions, which in some species are little more than thirty in a minute, in others amount to one hundred and forty in number, according to the species, have been denominated pulsations, and the organ itself has been termed a heart. To that viscus, however, it bears no resemblance, except in its contractions, which are, however, irregular. It neither receives nor gives motion to any circulating fluid. Its use appears to be, to imbibe and convert the fluid of the abdomen into fat, to serve as a supply in those numerous cases where much nourishment is suddenly required, as during the metamorphoses of youth, and the production of eggs in maturity. The peritoneal membrane appears destined to execute the same functions.*

If there is thus no heart, and no circulation of the nutritive fluid obtained from the food, in what manner is this fluid *aerated?* In reference to this subject, Cuvier justly observes, "le sang ne pouvant aller chercher l'air, c'est l'air qui va chercher le sang." (*Leçons*, IV. 165.) The object is accomplished by a very complicated apparatus On each side of the body are small orifices, termed *stigmata*, differing in number according to the species. These are formed by a cartilaginous ring, and in some cases furnished with one or more valves. Each orifice is the extremity of a short tube, which opens internally into a cavity, one on each side of the body, and extending from the head to the tail. From these lateral cavities arise innumerable tubes, termed *tracheæ*, most numerous at the termination of the stigmata, which convey the air to every part of the body To enable them to do this, their coats consist of an external and internal cellular membrane, with a middle layer, consisting of a cartilaginous string, spirally twisted, resembling the spiral tubes of plants These tracheæ, by their number and subdivisions, convey air to every part of the body, and form, indeed, the great bulk of its contents. In what manner the vitiated air is expelled, has not been ascertained in a satisfactory manner.

From this view of the nutritive system in insects, it appears that the chyle is absorbed by the inner surface of the alimentary canal; that it exudes from its external surface into the common cavity, that the tracheæ aerate this mass; and that, while the dorsal vessel and the peritoneal membrane prepare fat, the hepatic filaments separate from it bile, and probably urine. The existence of this last excrementitious fluid is evinced by the presence of urea in the excrement.

* See "*Observations on the Use of the Dorsal Vessel*," by M. Marcel de Serres, translated in *Annals of Philosophy*, IV. p. 346; V. p. 191, 369, and VI. p. 34.

IV.—*Organs of Reproduction.*

Insects have the sexual organs on different individuals, impregnation takes place internally by their union, and the females are all oviparous.

In the male, the sexual organs bear a closer resemblance to those of the mammalia than some of the higher classes. The *testes* may be regarded as two in number, situated one on each side of the abdomen. In some cases they appear a simple mass, while in others they are subdivided into a number of lobes, which may be regarded as so many separate organs. The *spermatic* ducts are two in number, varying greatly in length and the number of tubes, which, like roots, combine in their formation. They unite into a common duct near the penis; but, previous to doing this they are joined by the ducts of the vesiculæ seminales, and other accessory tubes, which, in different genera, exhibit a great diversity of character. The penis is usually a simple tube, in some cases protected at the base by two scales, which separate upon entering the vagina of the female, and thus prepare a passage for the penis, and serve likewise for retention. The external opening is usually situated at the extremity of the abdomen, beside the anus. In the libellulæ or dragon-flies, it is seated at the base of the abdomen.

The males of insects are seldom of so large a size as the females, and frequently exhibit peculiar characters in their abdomen, eyes, or antennæ, by which they may be distinguished.

The female organs exhibit fewer varieties of structure in the different genera than those of the other sex. The ovaria consist of numerous tubes, in which the eggs are prepared. These open into a common oviduct, terminating in the vulva. Previous to the termination of the oviduct, it receives the ducts of one or more vesicles. To the sagacity of John Hunter we owe our knowledge of the use of these: "In dissecting," says he, "the female parts in the silk moth, I discovered a bag lying on what may be called the vagina, or common oviduct, whose mouth or opening was external, but it had a canal of communication between it and the common oviduct. In dissecting these parts before copulation, I found this bag empty; and when I dissected them after, I found it full." (*Phil. Trans.* 1792, p. 186.) By the most decisive experiments, such as covering the ova of the unimpregnated moth, after exclusion, with the liquor taken from this bag in those which had sexual intercourse, and rendering them fertile, he demonstrated that this bag was a reservoir for the spermatic fluid, to impregnate the eggs as they were ready for exclusion, and that coition and impregnation were not simultaneous. It has not been determined, whether the same arrangement prevails in all insects. This is a very near approach to the external impregnation of the ova, as takes place in many fishes and reptiles.

The female insect may, in general, be distinguished from the male, by the superior size of the abdomen. In some cases, both males and females survive the process of generation, to repeat it again in another season. In other cases, the female only survives, while, in many, death ensues, upon the eggs being prepared and excluded.

The apparatus with which some insects are furnished, to enable them to place their egg in a proper situation, has been denominated the *ovipositor*. It is a continuation of the vulva, more or less strengthened by bony spiculæ, according to the nature of the substance it is destined to penetrate.

The period which elapses between the union of the sexes, and the laying of the eggs, extends to days in some, and even to months in others. The eggs themselves are either deposited at once, or at particular intervals. They are deposited under one or other of the following conditions. In the first, the egg, upon being deposited, is left to the influences of external circumstances, and the young, when hatched, to the resources of their own instinct. In the deposition of the egg, the wisest arrangements are made for the welfare of the young. The mother attaches them, in general, to those substances on which, upon being hatched, they are destined to feed. The butterfly attaches her eggs to a leaf; the flesh-fly deposits her's upon carrion; while others insert them into the young of other insects. Not a few females prepare a particular hole, in which they place the egg, and lay up for the young a suitable provision when they burst the shell. In the second, where the insects live in society, the eggs are deposited within the dwelling, and the young are reared and fed by the mother's care, or rather by barren females which act as slaves.

In the aphides, or *plant lice*, as they are called, the female retains the eggs at one time until they are hatched, and at another lays them like other insects. There is another circumstance no less remarkable in these insects,—one act of impregnation not only renders fertile the eggs of the individual, but the young produced from these eggs, and from the eggs of those, even until the ninth generation.

When the eggs are hatched, the young are termed grubs, maggots, caterpillars, or, technically, *larvæ*. In this state they are proverbially voracious, and their digestive organs are of much greater dimensions than when arrived at maturity. In the condition of larvæ insects possess a variety of members, as legs, suckers, hairs, and even stigmata, which they do not possess in their maturity. They are all, however, destitute of wings. Some of them live constantly in the water, instead of the land, their future residence,—swimming in youth, and flying in maturity. The food of the larvæ is often solid, requiring powerful jaws to gnaw it, while the food of the perfect insect is fluid, and sucked up. When the larva has attained a certain size, and acquired the requisite quantity of fat, having been nourished either by the food which it has acquired by its own industry, as the caterpillars, or by that which has been brought to its cell, as in the grub of the bee, it prepares to assume the forms of maturity, by passing through the third stage of existence as a *pupa*. In this state, the parts, which were suitable only in the larva condition, either become obliterated, or are changed into organs fit for maturity. The following conditions of the pupa state are recognised by naturalists:

1. Some insects of the apterous tribes, merely by repeated castings of the skin, arrive at the perfect state without undergoing any sudden or remarkable change of form or structure. These are termed *Pupæ completæ*. They move and eat like the perfect insect.

2. Many insects, which have wings in the perfect state, are observed to obtain first the rudiments of them, and afterwards all their parts, and to assume the form of the perfect insect while passing through this period of youth, without any particular transformation. In this state they are called *Pupæ semicompletæ*. Like the pupæ completæ, they likewise move and eat like the perfect insect. In the different kinds of pupæ which remain to be considered, the animal neither eats nor moves. It derives its nourishment from its stores of fat.

3. After retiring to some suitable place, the larvæ of some insects cast their skin, and disclose the body of an ovate form, enveloped with a coriaceous covering, forming within separate sheaths for the different external organs. In this covering all the changes of form and structure take place, which prepare it for maturity. These are termed *Pupæ incompletæ*.

4. Other insects, likewise, upon changing their skin for the last time in their larva state, appear within a coriaceous covering, destitute, however, of any sheaths within for the external organs; these last being closely applied to the body. These are termed *Pupæ obtectæ*.

5. In the last form of the pupa, the skin, instead of casting, is changed into the coriaceous covering. Such are termed *Pupæ coarctatæ*.

All insects, which do not eat, and are motionless in the pupa state, are careful to retire to situations, sufficiently remote from enemies, of suitable temperature and moisture. In many cases, the larva forms an exterior covering, in which the pupa may be lodged with greater safety. This covering is in some composed of threads of the well known substance termed silk. Sometimes only one or two threads are required to keep the pupa in a proper position; in others, the silk is woven into cloth, or so matted together, as to resemble paper. These external cases are termed cocoons. The matter of which they are fabricated is prepared by two long tubes, which take their rise in the abdomen, enlarge as they approach the head, and terminate by a duct, which opens under the labium. By pressing the orifice of this duct to one place, and then to another, the larva draws out the tenacious threads.

The larvæ that live in cells ready fabricated for their reception, as the wasp and the bee, are not contented with these as a covering during the pupa state, but they line their sides and bottom, and cover their mouth with silk, thus making a complete cocoon. These, after the insect has been perfected, are left in the cell, and when it contains another larva, a second lining is likewise prepared. Each lining at the bottom, in the case of the bee, covers the excrement, which the animal had produced in its larva state. Hence, the walls of bee-combs appear double or treble; nay, John Hunter, by whom the appearance was observed, has counted twenty different linings in one cell. (*Phil. Trans.* 1792, p. 193.)

The external covering of the pupa, in some cases, consists of pieces of earth or dried leaves, curiously joined together, and cemented by an adhesive secretion.

After the insect has remained in a pupa state for a certain period, exceedingly different in the various tribes, it bursts forth from its confinement in its state of maturity. In this perfect condition it is termed the *Imago*. The organs of reproduction now speedily enlarge, and preparation is made to increase and multiply.

Method of Classifying Insects.

We now come to the second object proposed in this article, the modern method of classifying insects. The arrangement of insects has occupied the attention of many acute and accomplished naturalists. As yet, however, a considerable difference of opinion prevails, as to the characters which should be employed in the formation of the orders and other subordinate divisions.

Since the days of Swammerdam, there have not been wanting naturalists who have regarded the metamorphoses of insects as furnishing the most suitable characters for primary divisions. But, instead of adopting the four forms of metamorphoses of that author, they have divided insects into such as do not undergo changes of form in the third or pupa state, and such as do undergo changes.

Linnæus, to whom zoology in all its branches was greatly indebted, gave to insects a uniformity of nomenclature, and a methodical arrangement, greatly superior to all his predecessors. His primary divisions were taken from circumstances connected with the condition of the wings. The simplicity of this method, and the obviousness of the characters which have been employed, have obtained for this system a decided preference among the entomologists of Britain. Perhaps the strongest objection which can be urged against this method is its limited nature, arising from the great increase of species, and the consequent influx of new characters calling for the formation of additional divisions.

Fabricius introduced a method of classifying insects, founded on the organs of the mouth, which has met with many admirers. These *instrumenta cibaria* furnish permanent and definite characters, and exhibit, in the modifications which they present, marks well calculated for fixing the limits of species and genera. They are, however, in many cases minute: careful dissection is requisite for their display; and not unfrequently the aid of the microscope is necessary.

All the organs which compose the animal frame have certain mutual relations, so that any remarkable modification in the structure or functions of one set of organs is usually accompanied with corresponding changes in the other systems. Thus in the case of insects, when we observe any remarkable modifications taking place in the masticating organs, we observe equally remarkable variations in the locomotive organs, as these two systems of organs are correlative. Hence it happens that the divisions of the Linnean classification are frequently co-ordinate with those employed by Fabricius.

These considerations have induced modern ento-

[illegible] the [illegible] of Linnæus and Fabricius, and so add [illegible] Swammerdam. The characters employed by [illegible] occupy the first rank, because they are [illegible] to the senses. Those of Fabricius are [illegible] to the cases where the locomotive organs do [illegible] marks sufficiently characteristic.

In the following brief [illegible] of the modern state of the [illegible] of insects, [illegible] must necessarily be confined within very narrow limits. It would exceed the [illegible] of the present bulk were we to attempt to detail the characters of the genera, [illegible] to add an enumeration of the species. We the less regret this constraint, as the characters of the Linnean genera, and many of the species, with notices of their habits, have been presented to the reader in the *Encyclopædia*, under the article [illegible]. In Plates XXIV. and XXV. of this *Supplement*, there have been given examples of [illegible] species in all the classes.

CLASS I.

COLEOPTERA.

The insects of this class have their [illegible] arguments of a coriaceous consistence, approaching, in some genera, to the hardness of shell. The wings are four in number. The upper pair, denominated elytra, are of the same texture with the skin. They are convex above, concave below, and, when at rest, their mesial margins [illegible] by a straight suture. In some genera the elytra are [illegible] united at their suture, and in others the elytra at the base of the suture are in contact, or [illegible] each other, while at the extremity they recede from each other. The inferior pair of wings are membranaceous, strengthened by anastomosing ribs, and when at rest they are folded obliquely and transversely, and concealed under the elytra. When the insect is about to fly, the elytra are raised, and remain fixed while the under wings unfold and execute their motions. In some species, the under wings are [illegible] developed, or [illegible], and, consequently, flying is impracticable. [illegible] the elytra are cemented at the [illegible] consists of six or seven rings [illegible] the elytra, each of which have [illegible] each side. The antennæ exhibit a great variety of character in their situation, length, form, and number of the joints. The eyes are compound and two in number. Each eye, in some, is divided by the continuity of the marginal [illegible] of the head. There are no ocelli. The [illegible] are formed for cutting and masticating solid substances. The food, however, which is consumed by them differs greatly, according to the species, in kind and consistence, so that all the parts of the digestive system exhibit exten[illegible] modifications of form. They are all ovip[ar]ous. The larva is lengthened, frequently destitute of antennæ and eyes, [illegible] or thirteen rings, with a scaly head, and the [illegible] of the mouth similar to the perfect insect. [illegible] usually six feet. After continuing months, or [illegible] years, in the larva state, it changes into a pupa [illegible], through the skin of which the different members may be distinctly perceived. The

[illegible] coleoptera in their perfect state require a supply of food, [illegible] greater [illegible] than other insects. They are [illegible] numerous in species and genera. Linnæus [illegible] this extensive order into three groups, according as the antennæ were clavate, filiform, or [illegible]. M. Geoffroy employed the number of joints in the tarsi as the basis of his subdivisions. This method, though it separates a very few naturally connected genera, and is liable to some exceptions, is nevertheless so simple and easy of application, that it has been universally received throughout Europe.

I. [illegible] PENTAMERA.—Under this head [illegible] species which have five joints in each [illegible]. The genera which they form are distributed by Lamarck into three sections, according as the antennæ are *filiform*, including those which are moniliform [illegible] *setaceous*, *clavate* or *lamellate*. (*Hist. Nat. des Animaux sans Vertebres*, Tom. IV. p. 439.) Latreille, whose industry and acuteness have contributed greatly to extend the limits of entomology has [illegible] them in the following manner. (*Regne Animal*, [illegible] M. Cuvier, III. p. [illegible].)

I. PENTAMERA CARNIVORA.—The distinguishing character of the insects here referred to, and one which is peculiar to them, is the possession of six palpi, in place of four, the ordinary number, two of these attached to the labium, and two to each maxilla. The maxillæ are hooked, and covered on the inside with stiff hairs or spines. They have two stomachs. The first is short and muscular, the second more produced, with villous walls. The hepatic vessels are four in number, and terminate at the pylorus. The antennæ are filiform or setaceous. The thighs, of the middle and hind legs, furnished with large trochanters. They are carnivorous both in their larva and perfect state. In the former the body consists of [illegible], the head and the first ring scaly, with [illegible] antennæ.

Carnivora Terrestria.—The feet are formed for walking. The mandibulæ are apparent, the body is oblong, and the eyes prominent. The intestine terminates in a large cloaca, with two vesicles secreting [a] [illegible]trid humour.

1. CICINDELIDÆ. The maxilla are furnished with an articulated claw. Mandibulæ prominent, straight, and denticulated; eyes large and full; labium short, the tibia of the fore legs destitute of a notch on the inner side. In the genera Manticora, Cicindela, Megacephala and Therates, the breadth and the length of the thorax are nearly equal, and all the joints of the tarsus are entire. In the genus Collyris of Fabricius, changed by Latreille into Colliuris, the thorax is narrow, and produced, and the penult joint of the tarsus is bilobated.

2. CARABIDÆ. The maxillæ destitute of the articulated claw. In general, the head is narrower than the thorax, and the mandibulæ are destitute of teeth. This very numerous family has been divided by Latreille into seven sections.

1. The external maxillary and labial palpi, with the last joint equal or larger than the preceding. The tibiæ of the fore legs have a deep notch on the inner side; elytra truncated or obtuse; labium entire and oval, or nearly square; the head is contract-

Insecta.

ed behind; and, with the thorax, is narrower than the abdomen; the thorax is heart-shaped and truncated behind, and its length never exceeds, but frequently falls short of its breadth. This section includes the following genera: Anthia, Graphipterus, Brachinus and Lebia. This last genus has been subdivided into the following genera by Bonelli, viz. Hellus, Cymindus, Lamprias, Dromius, and Demetrias.

2. The genera of this section exhibit the same form of palpi and elytra. The head is deeply divided from the thorax, to which it is joined by a socket; the labium is furnished on each side with a lobe; the thorax is lengthened; the penultimate joint of the tarsi frequently bilobate. The genera are, Zephium, Galerita, Drypta, Agra, and Odacantha.

3. The palpi and tibiæ present the same characters as the preceding. The elytra are not truncated; the suture of the mentum is obsolete. This includes the genus Siagona.

4. The genera of this section differ from the preceding ones, in the tibiæ being denticulated externally. The second and third joints of the antennæ are nearly equal and moniliform; the elytra are entire, and the mentum articulated. This includes the genera Scarites and Clivina.

5. The elytra are entire; the mentum articulated; anterior tibiæ entire externally, with short terminal spines; labium pointed in the middle, with lateral lobes. This section contains the genera Ozena, Morio, Aristus, Harpalus, Feronia, Licinus, Badister, Panagæus.

6. The elytra are entire, and the anterior tibiæ very slightly, or not at all notched; labium pointed. This includes Cychrus, Pamborus, Calosoma, Carabus, Nebria, Omophron, Pogonophorus, Loricera, and Elaphrus.

7. In this last section, two at least of the exterior palpi are pointed at the extremity. The anterior tibiæ are notched. Bembidion, Trechus, and Apotomus.

II. *Carnivora Aquatica.* The feet of the insects here referred to are formed for swimming. The mid and hind legs are compressed or ciliated; the mandibules are concealed; the terminal hook of the maxillæ bent from the base; the thorax is broad; they live in the water both in the larva and imago state. The larvæ are long and narrow, with twelve rings; the head large, with strong hooked mandibulæ, pierced at the apex. The body has six feet.

1. Dyticidæ. The antennæ are filiform, and longer than the head. In the males of many species, the three first joints of the tarsi of the mid and fore-legs are dilated, and furnished with complicated suckers. In a few genera, the tarsi of the mid and fore legs have only four joints, as Hyphydrus and Hydroporus; in the others, the tarsi are entire, as Haliplus, Pelobius, Noterus, Laccophilus, Colymbetes, Hydaticus, Acilius, and Dytiscus.

2. Gyrinidæ. The antennæ are here clavate, with a subsidiary ciliated one at the base of each, each eye divided into two by the marginal band of the head. There is only one genus belonging to this family, Gyrinus.

II. Pentamera Microptera.—The insects of this division constituted the genus Staphylinus in the Linnean system. They are characterized by their filiform or moniform antennæ, sometimes thickening a little towards the end. The body is narrow, and the elytra scarcely reach to half the length of the abdomen. The coxæ of the fore and mid legs are remarkably large. Two bags are protruded at pleasure from the anus. They run and fly readily. When pursued, they elevate their head and abdomen, and assume a very threatening attitude. They frequent moist places, in the neighbourhood of putrid animal or vegetable substances. A few are found in flowers, in pursuit of minute insects. Their first stomach is very short, and without folds; the second is long and villous, with a short intestine. The species are very numerous, and have been divided into many genera, which admit of the following distribution:

1. Head exposed, and separated from the thorax by an obvious mark. Among these there are some which have the labrum deeply divided into two lobes. The Staphylinidæ are distinguished by their filiform palpi, and consist of the following genera: Staphylinus, Pinophilus, and Lathrobium. The Oxyporidæ have the four palpi, or at least the labial ones, terminated by an enlarged joint, as in Oxyporus and Astraphæus. In other genera, the labrum is entire. In the Pœderidæ, the maxillary palpi are nearly the length of the head, as in Pœderus, Evæsthetus, and Stenus. In the Oxytelidæ, the maxillary palpi are greatly shorter than the head, and the antennæ are inserted in front of the eye, as in Oxytelus, Siagonium, Omalium, Piestes, Proteinus and Lesteva. The Aleocharidæ differ from the preceding family in the antennæ being inserted between the eyes, as in Aleochara.

2. Head sunk in the thorax as far as the eyes. In the Lomechusidæ, the tibiæ are entire, as in Lomechusa. In Tachinidæ, the tibiæ are spinous, as in Tachinus and Tachyporus.

III. Pentamera Serricornia.—The elytra cover the abdomen; the antennæ are usually filiform, or slightly clavate; and, in the males particularly, serrated, pectinated, or plumose. In some of the genera, the thoracic sternum is advanced in front, under the head, and likewise produced behind. This character is exhibited in those which have the mandibles notched or bifid at their extremity, as the Elateridæ, a numerous family, in which the natural genera have not yet been established; and, in those which have entire mandibles, as Buprestidæ, having filiform palpi, and containing the genera Buprestis, Tracys, and Aphanisticus: and the Melasidæ, in which the palpi have an enlarged terminal joint, as Melasis and Cerophytum.

In those whose thoracic sternum is destitute of the singular character exhibited by the preceding families, there are several genera in which the mandibles are forked at the apex, or furnished with a tooth beneath. In some the body and elytra are soft. In these the head is furnished with a neck in Lymoxylonidæ, in which the elytra do not embrace the abdomen, as Lymoxylon, Hylecætus, Atractocerus, and Cupes; and, in Mastigoidæ, in which the abdomen is embraced by the elytra, as in Mastigus and Scydmænus. In others, the neck is concealed, as in

MALACHIUSIDÆ, which exhibit, as a peculiar character, four vesicles divided into lobes, under the thorax and the base of the abdomen, which can be withdrawn or exerted and inflated at pleasure. The MELYRIDÆ have the palpi filiform, as Melyris Dasytes, and Drilus; while in CLERUSIDÆ, the palpi are securiform as Clerus, Tillus, and Enoplium.

In those families where the body and elytra are firm and crustaceous, the PTINUSIDÆ have the head and thorax narrower than the abdomen, with the antennæ about the length of the body, as Ptinus and Gibbium; and the ANOBIUMEDÆ, having the thorax of the size of the abdomen, and the antennæ much shorter than the body, as Anobium, Ptilenus, and Dorcatoma.

There are several genera which agree with some of the preceding in the softness of their bodies, but whose mandibles are entire at the apex. In some of these the palpi are filiform, as in the CEBRIONIDÆ, which have tarsal joints entire, as Cebrio and Hammonia; and in SCIRTESIDÆ, which have the penultimate joint of the tarsus bifid, as Scirtes, Elodes, Rhipicera, and Dascillus. In others, the palpi, especially the maxillary ones, become thicker towards the extremities. In the LAMPYRIDÆ the antennæ are approximate at the base, and the maxillary are longer than the labial palpi, as in Lampyrus, Lycus, and Omalisus. In the TELEPHORIDÆ, the antennæ at the base are remote, and the labial and maxillary palpi are nearly of equal length, as in Telephorus and Malthinus.

IV. PENTAMERA CLAVICORNUA.—The antennæ are here obviously club-shaped, perfoliated or solid, generally exposed at the base, and longer than the maxillary palpi. In a few genera, forming the family DRYOPSIDÆ, the first and second joints of the antennæ are enlarged, and the remainder form a club nearly solid, so that they appear three jointed; as Dryops, Hydera, and Heterocerus. In the remaining families, the antennæ increase more gradually from the base, and the club consists of several joints. In some of these the pectoral sternum is produced under the head towards the mouth. In the HISTERIDÆ, the mandibles are prominent, and the antennæ geniculated, as Hister, Abræus, Onthophilus, Dendrophilus, and Platysoma. In the BYRRHIDÆ, the antennæ are straight, as Byrrhus, Throscus, Anthrenus, Chelonarium, Nosodendron, Elmis, Macronychus, Georessus, and Megatoma. In other genera, the pectoral sternum is abbreviated in the usual form, as the DERMESTIDÆ, which have the mandibles short, thick, and straight, at the extremity, as Dermestes and Attagenus. In the remaining families, the mandibles are lengthened, compressed, and hooked, at their extremity. The NITIDULIDÆ, the mandibles are notched, bifid, or furnished with a tooth at their extremity, as Nitidula, Biturus, Cateretes, Micropeplus, Thymalus, Colobicus, Engis, Ips, Scaphidium, Scaphisoma, and Choleva. The SILPHIDÆ have the extremities of the mandibles entire, as Silpha and Necrophorus. The insects of this family are reputed to feed on carrion, and to dig under dead mice and moles, and bury them in order to feast upon them more securely. These statements are without foundation. They feed on maggots, and their pupæ, and, in penetrating the ground in search of the last of these, they loosen the soil so much, that the dead animal sinks under, by its own weight, or, if light, is elevated on a hillock.

V. PENTAMERA PALPICORNUA.—The maxillary palpi nearly equal, or surpass the elevated antennæ in length. These last are inserted in a pit beneath an unusual production of the anterior margin of the head. In the HYDROPHILIDÆ, the first joint of the tarsus is abbreviated, and the legs are flattened, and formed for swimming, as Hydrophilus, Spercheus, Elophorus, and Hydræna. In the SPHERIDIADÆ, the five joints of the tarsus are distinct, as in Spheridium and Cercyon.

VI. PENTAMERA LAMELLICORNUA.—The insects of this division are readily recognized by their club shaped antennæ, the extremity of which is divided into laminæ, capable of receding or approaching at pleasure. The LUCANIDÆ differ from all the rest of this tribe in the laminæ of the club of the antennæ being placed (not as in the other families, approximating at the base, and opening and shutting like the leaves of a book, but) like the teeth of a comb perpendicular to the axis, as Lucanus, Sinodendron Esalus, Lamprima, Platyceres, and Passalus. In the COPRIDÆ, the membranaceous termination of the maxillæ is large and transverse; the antennæ have eight or nine joints; the labrum is concealed by the semicircular margin of the head; the mandibles are soft; and the last joint of the labial palpi comparatively small, as Copris, Aleuchus, and Aphodius. The GEOTRUPIDÆ have the terminal joint of the labial palpi as large as the preceding one: the antennæ have eleven joints, and the mandibles are horny as Geotrupes, Lethrus, and Typhæus. In the SCARABEIDÆ the antennæ have nine joints. The labrum is concealed by the mentum, as Scarabeus, Trox, Egialia, Oryctes, Hexodon, and Rutella. The MELOLONTHADÆ have the mandibles greatly concealed by the head and the maxillæ, as Melolontha and Anoplognathus. In the GLAPHYRIDÆ the labium is advanced and divided into three lobes, as Glaphyrus Amphicoma, and Anisonix. The TRICHIADÆ have membranaceous mandibles, as Trichius, Goliathus Cetonia, and Crematoschalus.

II. COLEOPTERA HETEROMERA.—The insects belonging to this great subdivision have the tarsi of the fore and mid legs furnished with five joints, as in the preceding, but the tarsi of the hind legs have only four joints. In a few genera, as Rhinomacer, Rhinosimus, and Stenostoma, constituting the family RHINOMACERIDÆ, the front of the head is advanced into a snout, on which are seated the antennæ. In the remaining genera, the front exhibits the usual characters. In some, the head is triangular, or heart-shaped, and is furnished with a neck, and the maxillæ have no corneous tooth on their inner edge. Among these, there are some which have the claws simple, as the PYROCHROIDÆ, with bilobate tarsi, including the genera Pyrochroa, Notoxus, Scraptia, and Dendrocera. In the MORDELLADÆ, in which the tarsi of the hind legs at least are simple, are included the Mordella, Rhipiphorus, Anapsis, Horea, and Apalus. Among others, the claws are double, or deeply divided. In the genus Tetraonix, the penultimate joint of the tarsi is bilobate in the others entire. In the MYLABRIDÆ, the an-

tennæ are thickened at the extremity, as in Mylabris, Hycleus, Cerocoma, while in the CANTHARIDÆ, the antennæ are of equal thickness throughout, or rather taper towards the point, as Cantharis, Meloe, Zonites, and Onas.

Among those genera which have the head oval and destitute of a neck, there are some which have the maxillæ furnished with a corneous tooth on the inner side. The elytra in some are free, and cover membranaceous wings, as the TENEBRIONIDÆ, including Tenebrio, Opatrum, Crypticus, Sarrotrium, and Toxicum. In many other genera, th elytra are united, and the membranaceous wings are nearly obliterated. Some of these have the maxillary palpi filiform, with the last joint nearly cylindrical. The ERODIUSIDÆ have the maxillæ covered with the mentum, as Erodius and Pimelia In the SCAURUSIDÆ, the base of the jaws are exposed, as Scaurus, Tagenia, Sepidium, Moluris, Tentyria, Hegester, Eurychora, and Akis Others have the extremity of the maxillary palpi enlarged, or securiform. In the ASIDADÆ, the base of the maxillæ is concealed by a large mentum, as Asida and Chiroscelis. In the BLAPSIDÆ, the base of the maxillæ is exposed, as in Blaps, Misolampus, and Pedinus.

The genera, in which the maxillæ are destitute of a corneous tooth on the inner side, are likewise numerous. Many of them have the antennæ cylindrical, or slightly tapering e MELANDRIADÆ have the penultimate joint of the tarsi bilobate, as Melandria, Lagria, C lopu Nothus, Odemera, Stenostoma, and Rynomacer. In he HELOPSIDÆ the joints of the tarsi, at lea t thos f the hind legs, are entire, as Helops, Serropalpu Hallomenus, Pytho, N and Cistela. Others the antennæ more less club-shape , and generally perfoliated. The HELEADÆ, including the g nera Helea and Cossy phus, have the head conce ed, or received into a notch in the front of the thorax. The remaining families have the head exposed and projecting. In the DIAPERIDÆ, the insertion of the antennæ is concealed by the lateral margin of the he d, as in Diaperis, Hypophleus, Trachyscelis, Eledona, Cnodalon, and Epitragus In the LEIODESIDÆ, the insertion of the antennæ is exposed, as in Leiodes, Tetratoma, Eustrophus, and Orchesia.

III. COLEOPTERA TETRAMERA.—The tarsal joints of all the feet are four in number. They are phytivorous, and live chiefly in wood or on flowers. In one extensive group, the head is produced in front, in the form of a snout. Among these there are two genera, Bruchus and Anthribus, in which the snout is short, and the labrum and palpi distinct. In the remaining genera the snout is long, and the labrum and palpi obscure. In the CURCULIONIDÆ, including the genera Curculio, Rhynchænus, Cionus, Calandra, and Rhina, the antennæ are distinctly geniculated. The Brentusidæ have antennæ destitute of the knee, as Brentus, Orchestes, Rhamphus, Brachycerus, Cylas, Apoderus, Attelabus, and Apion In another group, equally numerous, the forehead is of the usual size. Among these, there are some which have eleven joints in the antennæ, and the third joint of the tarsi bilobate. The antennæ, in some, terminate in a perfoliate club, as the EROTYLUSIDÆ, including Erotylus, Triplax, Lanugria, and Phalacrus. In others, the antennæ are filiform. In the CERAMBICIDÆ, the labium is dilated and heart-shaped at the extremity, including the genera Cerambix, Prionus, Callidium, Necydalis, Saperda, Lamia, Stencorus, Leptura, together with Spondylis and Parandra. In the CHRYSOMELINIDÆ, the antennæ are shorter than in the preceding family, and the labium is plain. It includes the following genera, Chrysomela, Cassida, Cryptocephalus, Clythra, Galeruca, Altica, Hispa, Crioceris, Donacia, and Sagra

In those which have not eleven joints in the antennæ, and the third tarsal joints bilobate at the same time, there are some which have the third tarsal joints entire. The MYCETOPHAGIDÆ have eleven joints in the antennæ, as Mycetophagus, Tleiota, Cucujus, Agathidium, Zylophila, Meryx, and Trogossita. In the BOSTRICHIDÆ, the joints of the antennæ do not exceed ten, as Bostrichus, Cerylon, Nemosoma, Cis, Cerapterus, and Pausus. The SCOLYTUSIDÆ have the penultimate tarsal joint bilobate, as Scolytus and Phloiotribus.

IV. COLEOPTERA TRIMERA.—The tarsi in this division are all three-jointed. The antennæ are clavate. In the COCCINELLIDÆ, the antennæ are shorter than the thorax, as Coccinella and Chilocorus In ENDOMYCHIDÆ, the antennæ are longer than the thorax, as in Endomychus, Lycoperdina, Dascarus, and Eumorphus.

V. COLEOPTERA DIMERA.—The tarsal joints are only three in number. The genera hitherto determined amount only to two, as Claviger and Pselaphus. The latter, however, has been recently constituted into a family, PSELAPHIDÆ, including Pselaphus, Euplectus, Bythenus, Acropagus, Tychus, and Bryaxis.

CLASS II.

STREPSIPTERA.

This class was instituted by Mr Kir one most acute and intelligent observers among the lish entomologists. The elytra (if such they can be called) are coriaceous, and arise, not from the upper side of the breast, but from the base of the coxæ of the anterior pair of legs, consequently they are remote from each other. They first recede from the body, then approach, and lastly recede again, exhibiting a tortuous course. They do not cover the wings. These last are firmly membranaceous, and their ribs are simple, diverging from the base, and folding longitudinally like a fan. The parts of the mouth are obscure, apparently consisting of two minute two-jointed palpi and two maxillæ, thus intimating that the imago consumes but little food, and is short lived. The antennæ arise, each of them from a common jointed base, and afterwards divide The eyes are pedunculated, two in number, and compound, with elevated septa, dividing the hexagonal lenses; the terminal segment of the abdomen ends in a reflected process. The larva inhabits hymenopterous insects, in which it changes into a pupa coarctata with the head exserted.

This order contains only two genera, Stylops and Zenos. In the former, the upper branches of the antennæ are jointed, in the latter they are simple. The Stylops melitta and tenuicornis are natives of Britain

Since the institution of this class, doubts have been entertained as to the propriety of denominating the twisted processes which arise from the sides of the thorax, elytra. Latreille and Lamark, without indicating much reluctance to increase the synonimes of the science, or delicacy towards the naturalist who first instituted the class, have suppressed the term Strepsiptera, the former substituting that of Rhipitera, the latter, with more classical propriety, Rhipidoptera (from ῥιπις), in reference to the fan-shaped wings.

CLASS III.

DERMAPTERA.

In this class, the elytra are short, coriaceous, with a straight suture. The wings are membranaceous, with longitudinal ribs, connected in the margin by a transverse one; they are folded when at rest longitudinally and transversely. The mandibles are bidentate. The maxilla have a scaly cylindrical appendix or galea There are no pyloric cæca. The tarsal joints are three in number. The metamorphosis is semicomplete. This class comprehends the following genera: Forficula, Labia, and Labidura

CLASS IV.

ORTHOPTERA.

The elytra, in the insects of this class, are coriaceous, and at their inner margin overlap each other. The under wings are membranaceous, and have numerous longitudinal ribs crossed alternately at right angles by an infinity of transverse ones, so that their reticulations, or little squares, are usually arranged like bricks in a wall; when at rest these are folded longitudinally, and unfold like a fan. The parts of the mouth are similar to the coleoptera, with the addition of the galea protecting the maxillæ at the sides. The alimentary canal is furnished with a membranaceous crop, and a muscular stomach, armed with corneous scales. The pyloric cœca receive the biliary vessels, and a few likewise terminate in the intestine. The larvæ exhibit a pupa semi-completa. In all the stages of existence they live on the land.

Among the Orthoptera, there are several genera with their wings, when at rest, roof-like. These have either the tarsi with four joints, as the LOCUSTIDÆ, or the tarsi have only three joints, as the ACHETADÆ, including the genera Acheta, Truxalis, Ziphicera, Acrydium, and Pneumora.

In the remaining genera, the wings are horizontal Among these the GRYLLIDÆ, including Gryllus, Tridactylus, and Gryllotalpa, have the body not flattened, nor the sides truncated, but the abdomen is furnished with appendages. In the genus Blatta, the body is depressed, and the sides truncated, with abdominal appendages. The remaining genera, with horizontal wings, are destitute of the abdominal appendages. These are the MANTIDÆ, including Mantes, Empusa, Phasma, and Spectrum.

CLASS V.

HEMIPTERA

The insects of this class exhibit considerable differences with regard to their wings. In some, the upper wings are true elytra, crustaceous, or coriaceous, with membranaceous extremities overlapping each other; while, in others, the upper wings are wholly membranaceous. In some of the genera, the males only are winged, or they are all apterous. They agree, however, in the characters exhibited by the parts of the mouth. These are formed for sucking. The labium is produced, with a canal on its upper surface, and consists of several joints. The mandibulæ and maxillæ appear like four hairs, which, by their union, form the haustellum. The labrum is more or less produced as a covering to the base of these organs. The palpi are nearly obliterated. The metamorphosis is here semicomplete. This class is divided into two orders, which, in the opinion of some naturalists, ought to be elevated to the rank of classes.

I. HEMIPTERA HETEROPTERA.—These have the elytra crustaceous at the base, and the extremities folding over each other, and membranaceous. The rostrum is attached to the front of the head. The first segment of the thorax larger than the second, ocelli, two. The Heteroptera admit of a division into the terrestrial and aquatic.

The terrestrial heteroptera have two ocelli, the antennæ exposed, longer than the head, and inserted between the eyes near the inner margin Some of these have the labium of four joints, and the labrum long, subulate, and striated above. Among these the PENTATOMADÆ have five-jointed antennæ, as Pentatoma, Cydnus, Tetyra, and Elia. The COREIDÆ have only four joints in the antennæ, as Coreus, Berytus, Lygæus Capsus, Miris, and Mydocha. In another group the labium consists of only three joints, sheathing the labrum, which is short In the REDUVIADÆ, the rostrum is curved, as Reduvius and Plocoria; while in CIMICIDÆ it is straight, as in Cimex, Tingis, Aradus, and Phymata. In a third group the labium consists of two or three joints, and does not embrace the labrum, as the ACANTHIDÆ, including Acanthia and Galgulus

The aquatic heteroptera live in or upon the water They are destitute of ocelli. In the HYDROMETRIDÆ, including Hydrometra, Velia, and Gerris, the antennæ are long, and inserted between the eyes In the remaining families, the antennæ are short, and inserted under the eyes, and are shorter than the head. In the NEPADÆ, the tarsi of the fore-legs are indistinct, as Naucoris, Nepa, and Ranatra. In the Notonectadæ, the anterior tarsi are distinct, as in Notonecta, Plea, Sigara, and Corixa

II HEMIPTERA HOMOPTERA.—In the insects of this division, the rostrum seems to originate from the chin. The second segment of the thorax is as long as the first. There are two or three ocelli The CICADIADÆ have three joints in the tarsi, the antennæ consist of six joints, and there are three ocelli, as Cicada. The FULGORADA have three tarsal joints and only three joints to the antennæ, and two ocelli as Fulgora, Flata, Issus, Tettigometra, and Delphax The CERCOPIDÆ differ from the preceding in the antennæ being inserted between the eyes, as Cercopis, Etalion, Ledra, Membracis, and Tettigonia The APHISIDÆ have two joints in the tarsi, as Aphis Psylla, Thrips, and Aleyrodes. The COCCIDÆ can boast of only one tarsal joint, as Coccus.

CLASS VI.

TRICHOPTERA.

The wings of the trichopterous insects are four in number, and membranaceous. The upper ones are usually of a darker colour and firmer consistence than the lower ones. The ribs, which are usually hairy, are disposed longitudinally, and when they do anastomose, the intervening spaces are lengthened. The lower wings fold longitudinally. The mouth has a distinct labrum; the maxillary palpi have five joints. The labial palpi have only three joints, the last of which is a little enlarged. The maxillæ and labium are united, but do not form a sucker. There are two large compound eyes, and two ocelli. The legs are spinous, and the tarsal joints five in number. The larvæ live in the water in tubular dwellings, which they construct and move about with, open at both ends, and consisting of bits of stick, sand, or shells. Hence, they are usually [illegible] *case worms*. They change into a pupa incomplete in the tube, which they inhabited when larvæ, and when ready for exclusion, by means of the sheathed antennæ, and fore and middle legs, crawl out of the water, throw off the covering, and become inhabitants of the land!

Dr Leach has subdivided this class into two families. The LEPTOCERIDÆ have the antennæ much longer than the whole body, as Leptocerus and Odontocerus. The PHRYGANIDÆ have the antenna only the length of the body, [illegible] Phryganea, and Limnephilus.

CLASS VII.

LEPIDOPTERA.

This extensive and beautiful class consists of the butterflies and moths. The wings are four in number, membranaceous in texture, irregularly ribbed, and covered with coloured scales, in the form of a farinaceous powder. The parts of the mouth are formed for suction. There are only vestiges of the labrum and mandibulæ. The maxillæ are produced, with a groove on the inner edge. When united, as they are naturally, they form a tubular proboscis, through which the animal obtains its food. The maxillary palpi are inserted upon the base externally, and are minute. The labium is short and without joints, and supports two obvious palpi with three joints. There are two compound eyes, and in some species two ocelli. The antennæ consist of many joints, and are usually much longer than the head. The segments of the thorax are united. The tarsal joints are six in number. The larvæ have six feet with claws, and from four to ten others on the posterior portion of the body, which they use as suckers. They are changed into a pupa obtecta. The genera are now divided into three orders, corresponding with the Linnean genera Papilio, Sphinx, and Phalæna.

I. LEPIDOPTERA DIURNA.—The upper wings, at least, in all the species are vertical in a state of rest, and the lower ones are destitute of hooks. The antennæ are clavated, or filiform, with hooked extremities. Among these, the PAPILIONIDÆ have the hinder tibiæ furnished with two spines, situated at the tarsal end, as in Papilio, Parnassius, Thais, Pieris, Polyomatus, Heliconius, Danaus, Cethosia, Libythea, and Nymphalis. The HESPERIADÆ, including Hesperia and Urania, have four spines to the hinder tibiæ, two in the middle and two at the tarsal extremity, as in the remaining lepidoptera.

II. LEPIDOPTERA CREPUSCULARIA.—The wings are horizontal in repose, and the under ones are furnished with a spine under the base, at the external margin which enters a hook on the lower side of the upper wings, as in the following division. The antennæ are prismatic and fusiform. The GLAUCOPIDÆ have the antennæ bipectinated in the male at least, as Glaucopis, Stygia, and Procris. The antennæ, in the remaining genera, are simple in both sexes. The ZYGÆNIDÆ have the palpi slender and hairy, as Zygena, Sesia, and Macroglossum. The SPHINGIDÆ have large scaly palpi, as Sphinx, Smerinthus, and Castinea.

III. LEPIDOPTERA [illegible]TURNA.—The insects [illegible]cluded under this division have setaceous antennæ, diminishing in thickness from the base to the point. Among these, there are several families, in which the wings, when at rest, fold round the body. The PTEROPHORIDÆ have the margins of two of the wings, at least, divided into processes at each rib, as Pterophorus and Orneodes. The other families of the division have the four wings entire. The TINEADÆ have only two palpi apparent, as Tinea, Yponomeuta, Oecophora, Lithosia, and Adela. In the ALUCITADÆ, there are four palpi apparent, as Alucita, Crambus, and Galleria. Other families have the wings at rest, lying upon the body without inclosing it, and by their union form a lengthened triangle. The AGLOSSADÆ have four apparent palpi, as Aglossa and Botys. The PYRALIDÆ have only two apparent palpi, as Pyralis, Hermenia, and Platypterix. In the third division, the wings do not rest upon the body so as to form a triangle. This extensive family includes the following genera, Phalæna, Campæa, Noctua, Calamorpha, Bombyx, Furcula, Hepialus, and Cossus.

M. Savigny has observed, that, in those cases where the maxillary palpi have only two joints, the proboscis is naked or pubescent, and when they consist of three joints, the proboscis is always scaly.

CLASS VIII.

NEUROPTERA.

The wings in this class are generally four in number, wholly membranaceous, transparent, and greatly reticulated by the anastomosing ribs. The under wings are either larger or longer than the upper ones. The labrum mandibulæ, maxillæ, and labium, are of the ordinary size, and formed for cutting. There are two large eyes, and two or three ocelli. The segments of the thorax are united, support the six legs, and are distinct from the abdomen.

In some of the families, the antennæ are about the length of the head, subulate, and consist of from three to seven joints, the last of which is setaceous. Among these the LIBELLULIDÆ, including Libellula, Aeshna, and Agrion, have three tarsal joints, the mandibulæ and maxillæ corneous, and the terminal ring of the abdomen, furnished with hooks or scales. In the EPHEMERADÆ, the mandibles are obscure,

the tarsal joints four in number, and the terminal ring of the abdomen furnished with setæ, as in Ephemera, Baetis, and Cloeon.

In other families, the antennæ are much longer than the head, and consist of sixteen joints and upwards. Among these the PANORPADÆ, including Panorpa, Nemoptera, Bittaces, and Boreus, have the front produced into a snout. The remaining families have the front short. In the MYRMELIONEDÆ the antennæ are clavate, and the palpi six in number, as Myrmelion and Ascalapus. The two remaining families have filiform antennæ. The TERMESIDÆ have from two to three tarsal joints, as Termes and Psocus. The HEMEROBIADÆ have four or five tarsal joints, as Hemerobius, Raphidia, Mantispa, Scalis, Corydalis, Chauliodes, and Osmylus. The PERLADÆ, including Perla and Nemoura, have the inferior wings folded longitudinally.

CLASS IX.

HYMENOPTERA.

The wings are four in number, membranaceous, and divided into large unequal meshes by the anastomosing ribs. The under wings are the smallest. The organs of the mouth are adapted both for cutting and sucking. For the former operation the labrum and mandibulæ are sufficiently strong; while the maxillæ are, together with the labium, more or less produced, and by their union, form a sucker. They have two labial and two maxillary palpi. The eyes are large, and the ocelli three in number. The females are armed with a sting or piercer. Many of the species live in society, and exhibit, in the magnitude and regularity of their operations, the most striking displays of the attributes of the social instinct. The insects of this class admit of a division into two orders.

I. HYMENOPTERA TEREBRANTIA.—The females of this order are furnished with a produced ovipositor, frequently of sufficient strength to pierce the bodies in which the eggs are deposited. Among these, there are two families in which the piercer is tubular, and does not consist of separate valves. The CHRYSIDÆ have the piercer formed of the last rings of the body, retractile, and furnished with a small sting, as Chrysis, Parnopes, and Cleptes. In the OXYURIDÆ, the piercer is protuberant, without a sting, as Oxyurus and Drynus. In the remaining families the piercer consists of several valves. In some of these the abdomen is united to the thorax by a small portion of its transverse diameter. Among these there are some which have all the wings with ribs. The ICHNEUMONIDÆ have upwards of twenty joints in the antennæ, as in the following genera, Ichneumon, Zorides, Crypturus, Agathis, Sigalphus, and Alysia. In the EVANIADÆ, including Evania and Fœnus, the joints of the antennæ do not exceed fifteen in number. In others, the under wings are destitute of ribs. The CYNIPSIDÆ have the antennæ broken, with from six to twelve joints, as Cynips, Leucopses, Chalcis, and Cynipsillum. The DIPLOLEPIDÆ have the antennæ straight, with from eleven to sixteen joints, as Diplolepis and Eucharis.

The remaining families have the abdomen united to the thorax by the whole of its transverse diameter. In the SIREXIDÆ the piercer consists only of three valves, the lateral ones serving as sheaths, as Sirex and Oryssus. In the TENTHREDADÆ, including Tenthredo, Cimbex, Hylotoma, Xiphedria, and Pamphilius, the piercer consists of four valves, the internal pair serrated.

II. HYMENOPTERA ACULEATA.—In this order are included such as have no ovipositor or piercer. The abdomen in the females, however, is usually furnished with a sting, and poison bags. The antennæ have thirteen joints in the male, and twelve in the female. These may be again reduced into two divisions. In the first, the feet are not formed for collecting pollen, and the first tarsal joints are cylindrical. Among these, there are two families, in which the ocelli are indistinct, and the neuters or females are apterous. The FORMICADÆ, including Formica, Polyergus, Ponera, Myrmica, Atta, and Cryptocerus, have males, females, and neuters, the last of which are apterous. They live in societies. The MUTILLADÆ have no neuters, and the females are apterous, as Mutilla, Dorylus, and Labidus. They are solitary. The others have the ocelli distinct, and are all furnished with wings. Among these there are some families in which the wings are always expanded. In the SCOLIADÆ, the first segment of the thorax is large, and extends above to the base of the upper wings, as in Scolia, Tiphia, Sapyga, Thynnus, and Pampilus. In the SPHEXIDÆ, the first segment of the thorax is narrow and distant above from the base of the upper wings, as in Sphex, Bembex, Larra, Crabro, and Philanthus. There are other families in which the upper wings fold longitudinally. In the MASARIDÆ, the mandibles are narrow. There are only males and females, which are solitary, as Masaris, Synagris, Eumenes, and Zethus. In the VESPADÆ, which are social, there are males, females, and neuters; the mandibles are large, as Vespa and Polistes.

In nearly all the remaining genera, the hind legs are made for carrying pollen, having the first tarsal joint enlarged and compressed. Among these are some in which the tongue, or intermediate process of the labium, is as long, or longer than its sheath, and deflected when at rest. In the Apidæ, which are social, there are males, females, and neuters, as Apis Melepona, Bombus, Euglossa, Eucera, and Anthophora. While agreeing with the preceding in many particulars, the following genera are destitute of the expanded tarsal joint, for carrying pollen, Systropha, Panurgus, Zylocopa, Ceratina, Megachile, Phileremus, and Nomada. Others have the tongue shorter than the sheath, as the ANDRENADÆ, including Andrena, Halectus, and Colletus.

CLASS X.

DIPTERA.

The insects of this class have only two wings, and, in a few instances, none. Many species are furnished with *halteres*, and squamulæ. The mouth is formed for suction. For this purpose, the labrum is more or less produced as a cover. The mandibulæ are obliterated, or in the form of threads. The maxillæ are produced into threads, and by their union in company with the mandibulæ, form the syphon. The labium is either double or single, and forms a

sheath, destitute of joints, for the reception of the syphon. In some cases, there are two maxillary and two labial palpi. The larvæ are destitute of feet, and pass into pupæ *obcctæ*, or coarctatæ. In this numerous division, the labium, or sheath, is univalve, in others it is bivalve. We shall now advert to the first of these.

Among those with a univalvular sheath to the proboscis, there are some in which this sucking organ is entirely withdrawn, when not in use. Some of these have the sucker consisting of only the produced maxillæ. The Muscadæ have the eyes sessile, at Musca, Tephritis, Myoda, Macrocera, Scenopinus. The Achiasidæ have the eyes pedunculated, as Achias, Diopsis. The genus Oestrus, or Gad-fly, agrees with the muscadæ in habit, but the parts of the mouth are imperfect. Others have the sucker of four filaments, formed from the mandibulæ and maxillæ. In the Syrphidæ, the front is produced like a beak, as Syrphus, Psarus, Chrysotoxum, Cerea, and Rhingia. In the Aphritadæ, the front is abbreviated, as Aphritis and Milesia. In the remaining genera of this group, the last joint of the antennæ is not simple, as in the preceding families, but annulated, and destitute of the lateral hair which they possess. These are termed Stratiomydæ, and include the genera Stratiomys, Oxycera, and Nemotelus.

In the remaining families, with a univalvular sheath, the proboscis is always more or less protuberant. Among these, there are some which resemble the preceding families, in having only three joints in the antennæ. The Conopsidæ have the sheath bent, and the sucker, with two filaments, as Conops, Zodion, Homoxis, Bucentes, and Myopa. The Bombylidæ have the sucker composed of from four to six filaments, and the sheath is destitute of large lips, as Bombylus, Ploas, Mithrax, Nemestrina, Panops, Cyrtus, Acrocera, Astomella; together with Empis, Asilus, and Dioctria. The Tabanidæ have the sheath furnished with large lips, and the third joint of the antennæ distinctly annulated; as in Tabanus, Pangonia, and Cænomya; together with Pachystoma, Rhagis, Dolechopus, and Mydas. Others have six joints or more in the antennæ. Among these the Bibionidæ have moniliform or perfoliated joints, about the length of the head, as Bibio, Scathopsis, and Simulium. The Tipuladæ have filiform or setaceous tentacula, as Tipula, Cetenophora, Trichocera, Psychoda, Tanypus, Limonia, Hexatoma, and Culix, all of which are destitute of ocelli; together with Asindulum, Ceroplatus, Mycetophila, and Rhyphus, which are furnished with ocelli.

In the remaining genera of this class, the sheath of the sucker is bivalve. Hypponoscidæ have the head distinctly divided from the thorax, as in Hippobosca, Feronia, Ornithomyia, Craterina, Oxypterum, and Melophagus. In the genus Nycteribia, the head is united with the thorax.

CLASS XI.

APTERA.

Into this class we have placed tribes of insects, which differ greatly from each other in the organs of digestion; but which do not agree with any of the preceding classes. They possess one common character in wanting wings, in all the stages of their existence. They may be divided into three orders, which by some are elevated to a primary rank.

I. Aptera Suctoria.—The head, thorax, and abdomen intimately united. The mouth consists of two simple processes, the lowest of which is longest, and receives the superior one in a cavity in its upper side. On each side is a process of four joints covering the others. These unite to form a proboscis, which rests upon the sternum. Are the simple processes to be considered as the labrum and labium, and the articulated lateral ones as palpi, the mandibulæ and maxillæ being absent. The antennæ consist of four joints. This order contains at present only one genus, Pulex or Flea. There are several species. The P. irritans is every where common, and the P. fasciatus of Bosc may be met with on moles and mice.

II. Aptera Thysanura.—The head in this and the following order is obviously separated from the thorax by a contraction or neck. The last segment of the body is furnished with long filaments. In the Lepismadæ the setæ of the tail are continually extended in the direction of the body, as Lepisma and Forbicina. In the Poduradæ, the setæ, when at rest, are folded under the body, as Podura and Smynthurus.

III. Aptera Parasita.—The tail in this order is simple, or destitute of the filaments which distinguish the preceding. The Nirmidæ, including numerous species of lice which infest birds, and included in the genera Ricinus and Pediculus of authors, have the mouth furnished with two teeth. The Pediculidæ have a tubular proboscis, and include the genera Pediculus, Phthirius, and Hæmatopinus. (Q.Q.)

DESCRIPTION OF THE PLATE.

1. A, The stag-beetle (Lucanus) seen on the back. (Class Coleoptera.) B, The under side, exhibiting the position of the legs, and on one side the pits for the reception of the coxæ. C, The parts of the mouth displayed; *a*, the labrum, with its broad nasus; *b*, the mandibulæ; *c*, the maxillæ, with their jointed palpi; *d*, the bifid labium, with the two palpi and broad mentum.

2. The parts of the mouth of Cimex nigricornis. (Class Hemiptera.) *a*, The articulated labium, with the edges at each side, and the first joint of each of the antennæ. This is the sheath for the other organs, and exhibits the groove on its oral surface; *b*, the sucker viewed from above, covered at the base for one-third of its length, with the subulated labrum, and exhibiting, at the extremity, the straight united tip of the maxillæ, and the recurved ends of the mandibulæ; *c*, is a view of the same parts separated, with the labrum removed, to exhibit the expanded roots of the mandibulæ and maxillæ, the small opening of the pharynx, and the pointed lingua before it and between the maxillæ.

Insecta || Interest.

3. Exhibits the parts of the mouth of the Nepa (Hepa neptunia, Savigny *Mémoires,* I. Pl. IV. fig. 3. Class Hemiptera), the labrum and palate being removed. The mandibulæ appear at the sides, their summits with reflected spiculæ, and their roots near the pharynx flask-shaped. The tongue is trifid at the apex, underneath which the maxillæ arise and exceed the mandibulæ. The labium exhibits the groove for the reception of the other parts, and the oval raised marks near its extremity are the vestiges of palpi.

4. Parts of the mouth of Papilio machaon. (Class Lepidoptera.) *a,* The head viewed in front, exhibiting the round eyes, one turn of the spiral proboscis, with the pilose labial palpi on each side; *b,* the tubular spiral maxillæ (which by their union form the proboscis), with the vestiges of palpi at their base. The circular apertures on each side, at the bottom of the figure, indicate the insertion of the labial palpi; *c,* the cleft labium and the two palpi, the left one deprived of its scales; *d,* the minute labrum, with the mandibulæ on each side of it ciliated on their internal edge.

5. Parts of the mouth of the Lyndia cannurum of Savigny. (Class Lepidoptera.) *a,* The eyes, scaly spiral proboscis, and the four palpi; *b,* one of the maxillæ with its palpus; *c,* the labium and palpus; *d,* the labrum and mandibulæ.

6. The parts of the mouth of Tabanus italicus. (Class Diptera.) *a,* The mouth opened, or labrum and the mandibulæ and lingua separated, to exhibit the pharynx; *b,* one of the mandibulæ viewed laterally; *c,* one of the maxillæ with the articulated palpus, the last joint of which is greatly enlarged; *d,* the labium with its fleshy lips. (Q.Q.)

INTEREST

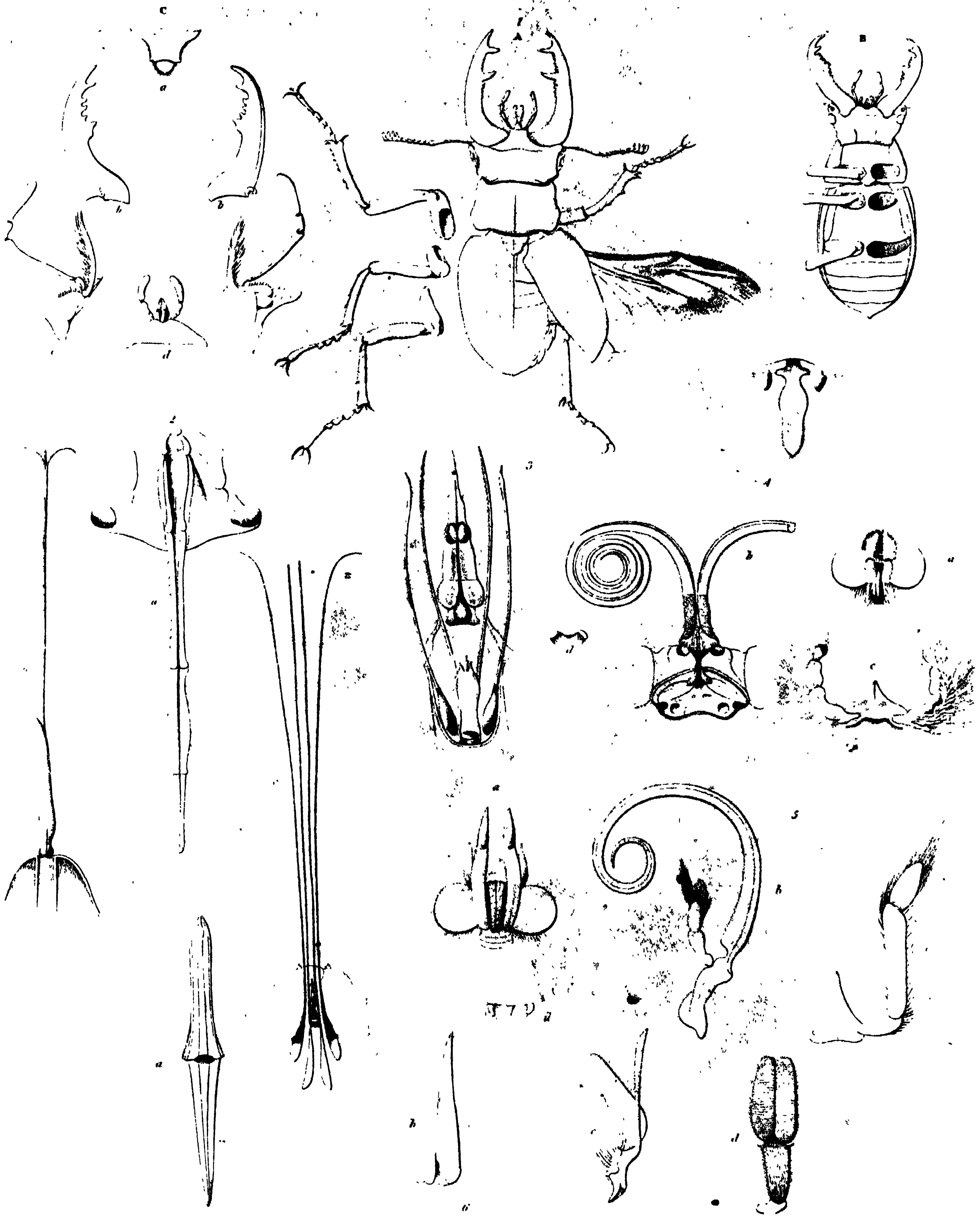
Rate of Interest is not regulated by the supply of money, but by the relation between the supply of real disposable capital, and the power of advantageously employing it.

Is the sum which the borrower of a *capital* obliges himself to pay to the lender for its *use.**

It was formerly universally believed that, in the event of all legislative enactments, fixing and regulating the rate of interest, being repealed, its increase or diminution would depend wholly on the comparative scarcity or abundance of money, or, in other words, that it would rise as money became scarce, and fall as it became more plentiful. Mr Hume was the first to point out the fallacy of this opinion *(Essay on Interest),* and to show that the rate of interest is not determined by the amount of the currency, but by *the average rate of profit derived from the employment of capital.* No doubt it most frequently happens that, when a loan is made, it is made in the currency of the country; this, however, is really of no consequence. There is obviously no difference between one individual furnishing another with 100 bushels of corn to be repaid at the expiry of a twelvemonth by the delivery of 104 or 105 bushels, or with as much money at 4 or 5 *per cent.* as would have purchased the corn. Besides, it is easy to perceive that the same identical sum of money might serve to negotiate an infinity of loans. Suppose A lends to X L.1000, which X immediately pays away to B for commodities of equal value; but B has no use for the money, and he, therefore, lends it to Y, who pays it away for commodities to C, who again lends it to Z, and so on; it is plain the borrowers, X, Y, Z, have really received a loan of commodities, or capital, from the lenders, A, B, C, worth *three* times (and it might have been worth three hundred or three thousand times) as much as the money employed in settling the transactions. According as the supply of currency, compared with the business it has to perform, is greater or less, we are obliged to give a greater or lesser number of guineas or livres, pound notes, or assignats, for the commodities we wish to obtain. It is plainly, however, by the *advantage* or *profit* we expect to derive from the acquisition of the commodities which constitute capital, and not from the accidental, and, in this respect, unimportant circumstance of a larger or smaller number of pieces of gold or silver, or of bits of engraved paper being given for them that the rate of interest, or the compensation given to the lender for the use of his stock, must be determined. It may perhaps be supposed, that when the quantity of metallic money is increased, goldsmiths, jewellers, &c. obtain the raw material for carrying on their business with greater facility; but this is not always the case, and, though it were, it would not affect the rate of interest. No coins are ever sent to the melting pot unless when the currency is either degraded or depreciated,—that is, unless it be deficient in weight, or *relatively* redundant in quantity. And it is clear that the inducement to promise a high or low rate of interest for loans of metallic money, which it was intended to work up into some species of manufactured goods, would depend not on the supply of such money, but on the profit to be derived from the operation,—a circumstance totally unconnected with the scarcity or abundance of coin.

It appears, therefore, that the rate of interest, at any given period, depends exclusively on the supply of real disposable capital, such as land, machinery, raw and manufactured products, &c. compared with the power of profitably employing it. An increase of metallic money adds only very inconsiderably, and an increase of paper money adds nothing whatever to the real capital of the country, or to the

* Interet: loyer d'un *capital* preté: ou bien, en termes plus exacts, achat des *services productifs* que peu rendre un capital. Say, Tome II. p. 480, Ed. 4me.



material of which all loans are really composed. If an increase of paper money was equivalent to an increase of capital, bank notes could not be too much multiplied, and France would have been about twenty times as rich at the era of the assignats as at this moment! It is not denied that considerable mischief and derangement must always be experienced in a highly manufacturing and commercial country like Great Britain, when any sudden check is given to the facility with which discounts are generally obtained, or when the currency is suddenly contracted. But the *frottement* and inconvenience occasioned by a contraction of the currency could only be temporary. It is impossible it could have any lasting effect on the industry of the country. We should still possess the same amount of real capital; and as neither its productive power, nor the liberty to transfer it from one individual to another, would be at all impaired, the real revenue of the state would continue as great as ever, and the same, or a greater amount of stock might be disposed of by way of loan. *Money prices* would certainly fall proportionably to the reduction of the currency; or, which is the same thing, the value of commodities would henceforth have to be ascertained by comparing them with a smaller number of bits of gold or paper. But, in every other respect, the business of society would continue exactly on its former footing; and without some change in the rate of profit, on which fluctuations in the value of money have almost no effect, the rate of interest would continue invariable.

Mr Ricardo has set this principle in a clear and striking point of view. "The rate of interest," he observes in answer to those who had contended that it would be increased by a diminution of the discounts of the Bank of England, "is not regulated by the rate at which the Bank will lend, whether it be 5, 4, or 3 *per cent.*, but by the rate of profit which can be made by the employment of capital, and which is totally independent of the quantity and of the value of money. Whether a bank lend one million, ten millions, or a hundred millions, they would not permanently alter the market rate of interest; they would alter only the value of the money which they thus issued. In one case, ten or twenty times more money might be requested to carry on the same business, than what might be required in the other. The applications to the Bank for money, then, depend on the comparison between the rate of profits that may be made by the employment of it, and the rate at which they are willing to lend it. If they charge less than the market rate of interest, there is no amount of money which they might not lend; if they charge more than that rate, none but spendthrifts and prodigals would be found to borrow of them. We accordingly find, that when the market rate of interest exceeds the rate of 5 *per cent.* at which the bank uniformly lend, the discount office is besieged with applicants for money; and, on the contrary, when the market rate is even temporarily under 5 *per cent.*, the clerks of that office have no employment." (*Principles of Political Economy*, 1st edit. p. 511.)

It is foreign to the object of this article to enter into any detailed examination of the causes which tend to elevate or depress the rate of profit. Whatever diversity of opinion may be entertained respecting them, it is abundantly evident that the rate of interest afforded for the use of borrowed capital must be proportionable to the profits which might be derived from its employment. In the United States, the market rate of interest varies from 10 to 14 *per cent.*; and in Holland, previously to the invasion of the French in 1794, it did not exceed 2 or 3 *per cent.* The immense extent of fertile and uncultivated land in America, the lowness of taxation, and the absence of all restrictive regulations, naturally occasion high profits, and consequently high interest; while the sterility and limited extent of the soil of Holland, the excessive load of taxes, laid equally on necessaries and luxuries, and the injudicious restraints imposed on various branches of commerce, by rendering it impossible to derive large returns from capital, proportionably sink the rate of interest. Had the soil of Holland been as fertile, and taxation as light as in the United States, profits and interest would, notwithstanding the abundant supply of capital, have been equally high in the one Republic as in the other. It is not by the absolute amount of the stock of a country, but by the comparative facilities for its advantageous employment, that the compensation or interest which a borrower can afford for its use must always be regulated. Previous to the termination of the late war, the market rate of interest in this country, for sums which could not be immediately demanded, fluctuated from 5 to 12 *per cent.* It has since fallen to 4 or 5 *per cent.*; a decline which has not, certainly, been occasioned by any sudden increase of capital, but by the extraordinary depression of commerce, and the consequent impossibility of investing stock so as to yield as large a profit as it did during the period when we engrossed almost the whole trade of the world.

Rate of Interest varies according to the security afforded for the repayment of the principal, and the duration of the loan.

Besides, such variations as are proportionable to variations in the general and average rate of profit, and which *equally* affect *all* loans, the rate of interest must vary according *to the degree of security afforded for the repayment of the principal, and the duration of the loan.* No capitalist would lend on the personal security of a gunpowder manufacturer, and on *mortgage* over a valuable estate, at the same rate of interest. The extraordinary hazard of the gunpowder trade exposes the stock invested in it to an extreme degree of *risk*. It may be dissipated in an instant; and the power of the borrower to refund the capital he had borrowed annihilated for ever. A lender of money on mortgage is almost entirely relieved from such contingencies. The owner of an estate on which a loan is secured may become bankrupt, but the estate itself will remain, and may be either sold or taken possession of by the lender. It is plain, therefore, that there must be a very great difference in the rate of interest paid by those whose security for the repayment of the principal is so exceedingly different. The gunpowder manufacturer, besides paying a rate, or *per centage*, equivalent to the common and average rate of interest derived from the most secure investments, would have to pay an *additional* rate, which, although it might not be designated by that name, would really

constitute a *premium* of insurance proportioned to the greater risk to which the lender was exposed of losing his principal. The preferable security offered by the landholder would relieve him from the necessity of paying any considerable premium, or excess of interest, on account of risk; and, of course, he would be able to borrow at so much less than the manufacturer. We should mistake, however, if we supposed that the latter was thus placed in a comparatively disadvantageous situation. He would be completely indemnified for the greater risk to which his stock was exposed, and for the higher rate of interest which he was, in consequence, obliged to pay, by the greater *gross profits* he would derive from his business. The constantly operating principle of competition will not permit, taking every thing into account, a greater *nett profit* to be permanently derived from one department of industry than from another. But those who invest their stock in employments of more than ordinary hazard, must be able to dispose of their produce at such a price as will yield them the common and average rate of profit, besides affording a surplus adequate to insure their stock against the extra risk to which it is exposed. If this were not the case, no capitalist would place his property in a state of comparative danger, and no undertakings of a hazardous nature would be entered into. Wherever there is risk, that risk must be compensated. And it may, and very frequently does, happen that the manager of a hazardous branch of industry, paying from 10 to 20 *per cent.* for borrowed capital, is realizing a larger nett profit than the landlord who has purchased an estate with money for which he only pays 3 or 4 *per cent.* *

But, supposing the securities to be equal, capital lent for *short* periods, or in such a way that the lender may obtain possession of it *at pleasure,* will always bring a lower rate of interest than capital lent for a considerable, or definite, period. No borrower could afford to pay so high a rate of interest for a capital of whose productive services he might be deprived in an instant, and which he could not, therefore, venture to invest in any employment from which it might not be easily withdrawn, as for a capital lent for a fixed period, especially if that period was of considerable length. But here, as in every other case, the real interests of the borrower and lender coincide. The same circumstances which prevent a borrower from giving as high a rate of interest for a loan payable on demand as if it were payable at a fixed and distant term, induces the lender to rest satisfied with a smaller compensation in the one case than in the other. We wish to be able to exercise a complete command over our capital. No merchant would ever consent to lend his stock on mortgage. If he did, he would no longer be able to carry on his business with advantage. He would be deprived of all power of speculating; and, although this might, in many instances, be for his advantage, yet the flattering opinion which every one entertains of his own abilities and good fortune, would but seldom allow him to doubt of its being a very material disadvantage. It is by this principle that we are able to account for the comparatively low rate of interest at which banking companies, who pay the sums deposited with them on demand, and governments, whose circumstances are perfectly desperate, are able to borrow. A stockholder's mortgage,—his claim on the revenue of the country,—can be immediately converted into cash at the current prices. And, however much the majority of the public creditors may be impressed with a conviction of the inability of the state to discharge *all* the claims upon it, every particular individual, confident in his own good fortune, foresight, and acuteness, flatters himself with the idea that *he*, at least, will be able to predict the coming tempest, and that *he* will be able to sell out before a national bankruptcy.

[illegible]

Instead, however, of leaving the rate of interest to be adjusted by the unfettered competition of the borrowers and lenders, on the principles we have thus briefly explained, the governments of most countries have interfered either to prohibit the taking of interest altogether, or to fix certain rates which it was declared legal to exact, at the same time that any excess over these rates was declared to be *usury*, and prohibited under the severest penalties. In the rude and unenlightened ages in which these enactments had their origin, the precious metals, then the only species of money, were considered as uninfluenced by the same principles which regulate the value of other products. Being used both as standards whereby to ascertain the comparative value of different commodities, and as the equivalents for which they were most frequently exchanged, they acquired a factitious importance, not merely in the estimation of the vulgar, but in that of persons of the greatest discernment. The simple consideration that all buying and selling is really nothing more than the bartering of one commodity for another,—of a certain quantity of corn or beef, for example, for a certain quantity of gold or silver, and *vice versa*, was entirely overlooked. The attention was gradually transferred from the money's worth to the money itself, and the wealth of states and of individuals came to be measured, not by the abundance of their disposable

* This principle is never lost sight of in bargaining for loans. In Athens, the rate of interest was not regulated by law; and it is distinctly mentioned in ancient authors, that the average rate of interest paid by those who employed their stock in the shipping trade with the countries situated on the Euxine and Mediterranean Seas, amounted, on account of the hazard of the voyage, to about 30 *per cent.*, while bankers, agriculturists, and others, whose security was preferable, paid only about 12 *per cent.* Say, in noticing this striking fact, supposes that the 30 *per cent.* was charged by the voyage; and that, as two voyages to the Crimea, or Sicily, might be made annually, *maritime* interest really amounted at Athens to 60 *per cent.* There does not, however, appear to be the least ground for this assertion. It is the average annual rate of interest that is always spoken of.—(*Travels of Anacharsis*, Vol. IV. p. 368, Eng. trans.; *De Pauw Recherches sur les Grecs*, Tom. I. p. 287; Say, Tom. II. p. 132.)

produce,—by the quantity or value of the commodities with which they could afford to purchase the precious metals,—but by the *quantity of these metals* actually in their possession. Because it sometimes happened that the holders of ordinary commodities were unable easily to dispose of them at any price, while money was always sure to find a ready and advantageous market, it was considered as something mysterious,—as a real *marchandise par excellence*. We cannot, therefore, be surprised at the measures to which the erroneous opinions entertained respecting it necessarily led; or that efforts should have been made to protect the interests of those who were unprovided with so powerful an instrument, from becoming a prey to the encroachments of their more fortunate neighbours. Every individual was allowed freely to dispose of his corn, cattle, land, &c.; but it was imagined there was something peculiar in money, and that the desire to obtain it was so great, that, unless the lenders were restrained in their demands, they would, by taking advantage of the necessities of the borrowers, infallibly ruin them, and engross the whole property of the country.

Another source of the prejudice against stipulating for interest must be sought for in the dislike so universally entertained in remote ages to accumulation. There can be no accumulation without economy,—without a saving of income,—and this was then not only considered as indicative of a sordid and avaricious disposition, but as being positively hurtful. Before the nature and functions of capital were properly understood, it was believed it could not be increased otherwise than by injuriously abstracting a portion of the national revenue, and that any advantage it might give to the proprietor, must have been obtained at the public expence. It did not occur to our ancestors, that an individual who, by his economy, has accumulated stock, has really added to the wealth of the state, without diminishing that of others; nor were they aware that this stock, when afterwards expended, as is almost always the case, in the support of productive industry, would afford the means of producing an increased income. But, reckoning as they did, the savings of individuals as so much withdrawn from the public income, it was natural enough that they should endeavour to limit the advantage to be derived from their employment.

Much, also, of the prejudice against bargaining for interest, so prevalent in the middle ages, may be traced to the authority of some texts of scripture, which were understood entirely to prohibit its exaction. It has, however, been shown, that these texts will not really bear this interpretation; but, supposing they had, nothing, it is plain, could be more absurd than to consider the municipal regulations of a people placed in such peculiar circumstances as the Jews, as general and fixed principles, applicable in all ages and countries.

The attempts to limit and restrain the rate of Interest, instead of reducing, have contributed to raise it.

But, whatever may have been the causes of the efforts so generally made to regulate and limit the rate of interest, it is certain that, far from succeeding in their object, they have had a precisely opposite effect. Should a borrower find it for his advantage to offer 6, 7, or 8 *per cent.* for a loan—and, unless it were for his advantage, nothing could possibly induce him to make such an offer—what right has the legislator to interfere, and to prohibit the lender from receiving, and the borrower from paying, more than 4 or 5 *per cent.*? Such an interference is not only uncalled for and unnecessary, but it is, in the highest degree, prejudicial. Restrictive laws, instead of reducing, have uniformly contributed to raise the rate of interest. Nor is this any thing but what might have been foreseen and expected. It is plain no law can be so framed as to prevent a borrower from offering a higher rate of interest than what is fixed by statute; and, if the lender had implicit confidence in the secresy and solvency of the borrower, he might accommodate him with the sum wanted, without requiring any additional interest or *premium of insurance*, because of the danger of entering into what the law declares to be an *illegal* transaction: but this must be a veryrare case. Gratitude, and a sense of benefits received, are, unfortunately, when they come into contact with self-interest, but slender securities for honourable conduct. Numberless unforeseen events occur to weaken and dissolve the best cemented friendships; and a transaction of this kind would undoubtedly afford an additional source of jealousies and divisions. In such matters, indeed, men are more than usually sharp-sighted, and are very little disposed to trust to moral guarantees for the security of their property. But neither the threatenings of the law, nor the powerful inducements which it holds out to dishonest debtors to break their engagements, and treacherously to recede from the stipulations to which they had agreed, have been able to prevent, or even greatly to lessen, what are termed *usurious* bargains. Their only effect has been, to oblige the lender to demand, and the borrower to bind himself to pay, a higher rate of interest than would otherwise have been required. A bargain for more than the statute rate of interest being declared illegal, the lender is thus exposed to an additional *risk*. But no person will gratuitously place his fortune in a situation of comparative hazard; and, therefore, the sum necessary to cover this risk, must be proportioned to the greater or less anxiety on the part of government to prevent and punish such bargains; or, in other words, the rate of interest is invariably increased according as the laws intended to reduce it become more severe, and diminished according as they are relaxed!

Thus a capitalist might be inclined to lend a sum at 6 or 7 *per cent.*; but, as the law declares that any individual who shall stipulate for more than 5 *per cent.* shall, if detected, forfeit *three times the principal*, it is clear, provided there was no method of defeating this statute, that there must be an end of all borrowing, except when the market rate of interest was below the statutory rate. Whenever it was above that rate, no person would be able to obtain a single farthing by way of loan. There could, then, be no transference of capital. It would continue locked up in the same hands; and the national property and welfare would, in consequence, suffer severely. Luckily, however, the mutual interest and ingenuity of borrowers and lenders have always proved an overmatch for the enactments of the law.

These have done nothing but fetter the transference of stock, and force the borrowers to pay a higher rate of interest for it. What might have been borrowed at 6 *per cent.*, had there been no hazard from anti-usurious statutes, is, on account of that hazard, raised to perhaps 8 or 10 *per cent.*; and, what is still worse, a contempt for the institutions of society, and a habit of carrying on business in a secret and underhand manner, is generated. The odium which attaches to a positively pernicious regulation weakens the respect which would otherwise be felt for those which are acknowledged to be advantageous; and that spirit of frankness, openness, and sincerity, which, wherever it predominates, is so highly valuable, is cramped in its developement, or altogether supplanted, by duplicity, extortion, and cunning.

Effect of the Usury Laws in Rome:

These conclusions do not rest on theory only, but are supported by a constant and uniform experience. At Rome, during the period of the Republic, the ordinary rate of interest was excessively high. The debtors, or plebeians, were every now and then threatening to deprive their creditors, who were generally of the patrician order, not only of the interest of their capital, but of the principal itself. Repeated instances occurred to show that these were not mere empty threats; and the patricians were, therefore, obliged to indemnify themselves, by means of a corresponding *premium*, for the risks to which they were exposed. "Des continuels changements," says Montesquieu, "soit par des loix, soit par des plebiscites, naturaliserent à Rome l'usure; car les creanciers, voyant le peuple leur debiteur, leur legislateur, et leur juge, n'eurent plus de confiance dans les contrats. Le peuple, comme un debiteur decredité, ne tentoit à lui prêter que par *des gros profits*; d'autant plus que, si les loix ne venoient que de tems en tems, les plaintes du peuple etoient continuelles, et intimidoient toujours les creanciers. Cela fit que tous les moyens honnêtes de pretér et d'emprunter furent abolis à Rome, *et qu'une usure affreuse, toujours foudroyée, et toujours renaissante, s'y etablit.* Le mal venoient de ce que les choses n'avoient pas été menagés. Les loix extremes dans le bien font naitre le mal extrême: *il fallut payer pour le prêt de l'argent, et pour le danger des peines de la loi.*" (*Esprit des Loix*, Liv. XXII. chap. 21.)

In the East:

In Mahometan countries, notwithstanding the positive prohibition in the Coran, the ordinary rate of interest is at least ten or twenty times as high as its ordinary rate in Europe. "L'usure augmente dans les pays Mahometans *à proportion de la séverité de la defense:* le prêteur s'indemnise du peril de la contravention." (*Esprit des Loix*, Liv. XXI. chap. 19.)

In the middle ages:

During the middle ages, the average rate of profit could not be much higher than at present: "But the clamour and persecution raised against those who took interest for the use of money was so violent, that they were obliged to charge it much higher that the natural price, which, if it had been let alone, would have found its level, in order to compensate for the opprobrium, and frequently the plunder, which they suffered; and hence the usual rate of interest was what we should now call most exorbitant and scandalous usury." (Macpherson's *History of Commerce*, Vol. I. p. 400.) The extraordinary risks to which lenders were exposed rendered the premium of insurance on all sorts of capital excessively high; for, of the 50, and even 100 *per cent.*, which borrowers then frequently engaged to pay as interest, not more than 8 or 10 *per cent.* can properly be said to have been given for the productive services of capital. The rest must be considered as a *bonus*, to compensate the lender for the hazard he encountered of losing the principal itself.*

In France

In France the rate of interest was fixed at 5 *per cent.* so early as 1665; and this, a few short intervals only excepted, continued to be the legal rate until the Revolution. Laverdy, in 1766, reduced it from 5 to 4 *per cent.* Instead, however, of the market rate being proportionably reduced, it was *raised* from 5 to 6 *per cent.* Previously to the promulgation of the edict loans might have been obtained on good security at 5 *per cent.*; but an additional *per cent.* was now required to cover the risk of illegality. This caused the speedy abandonment of the measure. (Storch, *Traité d'Economie Politique*, Tome III. p. 187.)

In Livonia

The same thing happened in Livonia in 1786, when the Empress Catherine reduced the legal rate of interest from 6 *per cent.* to 5. Hitherto, says Storch, *(in loco citato)*, those who had good security to offer, were able to borrow at 6 *per cent.*; but henceforth they had to pay 7 *per cent.* or upwards. And such will be found to have been invariably the case wherever governments have interfered to reduce the statutory below the market rate of interest.

History of the laws regulating the rate of interest in England.

From the earliest period of the history of England, down to the reign of Henry VIII., the taking of interest was absolutely forbidden to all persons within the realm except Jews and foreigners; who, nevertheless, were frequently plundered for the sake of enriching the Crown, under the miserable

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* It is impossible to form any very accurate estimate of the rate of profit in the middle ages, yet several striking facts may be adduced in support of the opinion advanced in the text. At Verona, in 1228, the interest of money was fixed by law at 12½ *per cent.* Towards the end of the fourteenth century, the Republic of Genoa paid only from 7 to 10 *per cent.* to her creditors; and the average discount on good bills at Barcelona, in 1435, is stated to have been about 10 *per cent.* But while the rate of interest in Italy and Catalonia, where a considerable degree of freedom was allowed to the parties concerned in bargaining for a loan, was thus comparatively moderate, it was, in despite of its total prohibition, incomparably higher in France and England. Matthew Paris mentions, that, in the reign of Henry III., the debtor paid 10 *per cent.* every two months; and this, though absolutely impossible as a general practice, may not have been very far from the average interest charged on the few loans that were then contracted for.—(Hallam's *History of the Middle Ages*, Vol. III. p. 402.)

Interest.

pretext of punishing them for what were then called their "hellish extortions." The disorders occasioned by this ruinous interference on the part of Government at length became so obvious, that, notwithstanding the powerful prejudices to the contrary, a statute was passed in 1546 (37th Hen. VIII. cap. 7.), legalizing the taking of interest to the extent of 10 *per cent. per annum;* and this, because, as is recited in the words of the act, the statutes "prohibiting interest altogether have so little force, that little or no punishment hath ensued to the offenders." In the reign of Edward VI. the horror against taking interest seems to have revived in full force; for, in 1552, the taking of *any* interest was again prohibited "as a vice most odious and detestable," and "contrary to the word of God." But, in spite of this tremendous denunciation, the ordinary rate of interest, instead of being reduced, immediately rose to 14 *per cent.;* and continued at this rate, until, in 1571, an act was passed (13th Eliz. cap. 8), repealing the act of Edward VI., and reviving the act of Henry VIII., allowing 10 *per cent.* interest. In the preamble to this act, it is stated, "that the prohibiting act of King Edward VI. had not done so much good as was hoped for; *but that rather the vice of usury hath much more exceedingly abounded,* to the utter undoing of many gentlemen, merchants, occupiers, and others, and to the importable hurt of the commonwealth." This salutary statute was opposed, even by those who, it might have been expected, would have been among the first to emancipate themselves from the prejudices of the age, with all the violence of ignorant superstition. Dr John Wilson, a man famous in his day, and celebrated for the extent and solidity of his learning, stated, in his place in the House of Commons, that "it was not the amount of the interest taken that constituted the crime; but that all lending for any gain, be it ever so little, was wickedness before God and man, and a damnable deed in itself, and that there was no mean in this vice any more than in murder or theft!" In order to quiet the consciences of the Bench of Bishops, a clause was actually inserted, declaring *all* usury to have been forbidden by the law of God, and to be, in its nature, sin, and detestable! When first enacted, this statute was limited to a period of five years; but, "forasmuch as it was by proof and experience found to be very necessary and profitable for the commonwealth of this realm," it was, in the same reign, made perpetual. (39th Eliz. cap. 18.)

In the 21st of James I. the legal rate of interest was reduced to 8 *per cent.*, by an act to continue for seven years only, but which was made perpetual in the succeeding reign. (3d Car. I. cap. 4.) During the commonwealth, the legal rate of interest was reduced to 6 *per cent.;* a reduction which was afterwards confirmed by the act 12th Car. II. And, finally, in the reign of Queen Anne, a statute (12th Anne, cap. 16) was framed, reducing the rate of interest to 5 *per cent.*, at which it now stands.

In the preamble to this statute, it is stated, that, "whereas the reducing of interest to ten, and from thence to eight, and thence to six in the hundred, hath from time to time, by experience, been found very beneficial to the advancement of trade and the improvement of lands; it is become absolutely necessary to reduce the high rate of interest of 6 *per cent.* to a nearer proportion to the interest allowed for money in foreign states." It was for these reasons enacted, that all bargains or contracts, stipulating for a higher rate of interest than 5 *per cent.* should be utterly void. And "that all persons who should after that time receive, by means of any corrupt bargain, loan, exchange, chevizance, or interest of any wares, merchandise, or other thing whatever, or by any deceitful way or means, or by any covin, engine, or deceitful conveyance for the forbearing or giving day of payment, for one whole year for their money or other thing, above the sum of L.5 for L.100 for a year, should forfeit, for every such offence, the *triple* value of the monies or other things so lent, bargained," &c.

Laws regulating the rate of Interest in Scotland;

In Scotland, previously to the Reformation, no interest could be legally exacted for money. But this great event, by weakening the force of those religious prejudices, which had chiefly dictated the laws prohibiting interest, occasioned the adoption of sounder opinions on the subject, and led to the enactment of the statute of 1587 (11th Parlt. Jac. VI. cap. 52), which legalized the taking of interest to the extent of *ten per cent.* In 1633 the legal rate was reduced to *eight per cent.*, and, in 1661, to *six per cent.* The statute of Queen Anne, reducing the rate of interest to 5 *per cent.*, extended to both kingdoms.

In Ireland.

The statutes prohibiting the taking of interest in Ireland were not repealed until 1635, when, by the statute 10th Car. I. cap. 22, liberty was given to stipulate for interest to the extent of *ten per cent.* In 1704 this rate was reduced to *eight per cent.;* in 1722 it was reduced to *seven per cent.:* and, in 1732, it was further reduced to *six per cent.*, at which it has since continued fixed.

Comparison between the market rate and the statutory rate of Interest, from 1714 to 1793.

It has been observed by Dr Smith, that the different statutory regulations, reducing the rate of interest in England, were made with great propriety. Instead of preceding, they followed the fall which was gradually taking place in the market rate of interest; and, therefore, did not contribute, as they otherwise must have done, to raise the rate which they were intended to reduce. Sir Josiah Child, whose celebrated Treatise, recommending a reduction of interest to *four per cent.* was published about 1670, states positively, that the goldsmiths in London, who then acted as bankers, could obtain as much money as they pleased, upon their servants' notes only, at 4½ *per cent.* The supposed insecurity of the revolutionary establishment, and the novelty of the practice of funding, occasioned the payment of a high rate of interest for a considerable portion of the sums borrowed by the public in the reigns of William III. and Anne; but private persons, of undoubted credit, could then borrow at less than 5 *per cent.* During the reign of George II. the market rate of interest fluctuated from 3 to 4 and 4½ *per cent.**

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* On the 18th December 1752, the *three per cents.* brought the highest price they have hitherto reached,

from obtaining loans from capitalists of the highest character, and force them to have recourse to those who are less scrupulous. Supposing the market rate of interest to be 6 or 7 *per cent.*, an individual, in ordinary good credit, might, were the usury laws abolished, easily obtain a loan at that rate. But the law having declared, that no more than 5 *per cent.* shall be taken, and consequently having affixed a species of stigma to those lenders who bargain for a higher rate, necessarily excludes the rich and more respectable capitalists from the market, and obliges borrowers to resort to those of an inferior character, who, in addition to the premium for the risk incurred by entering into an illegal transaction, must receive an indemnification for the *odium* which, in such cases, always attaches to the lender. It is idle and ridiculous to attempt to secure individuals against the risk of imposition in pecuniary, more than in any other species of transactions. But, although the object were really desirable, it could not possibly be obtained by such inadequate means. The usury laws generate the very mischief they are intended to suppress. Far from diminishing, they most unquestionably multiply usurious transactions in a tenfold proportion, and powerfully aggravate all the evils they were designed either to mitigate or remove.

Nothing can be more unreasonable, or more entirely unfounded, than the clamour that has been set up against usurers, as money lenders are sometimes termed, because of their exacting a higher rate of interest than ordinary from prodigals and spendthrifts. This surely is the most proper and efficient check that can be put upon the thoughtless or unprincipled extravagance of such persons. Supposing the security of a prodigal and of an industrious man to be nearly equal, and this can scarcely ever be the case, does not the capitalist, who would lend to the latter at a lower rate of interest than he would lend to the former, confer a real service on his country? Does he not prevent those funds which ought to be employed in supporting useful labour, and in adding to the real wealth of the nation, from being wasted in ridiculous extravagances or boisterous dissipation?

They do not protect the prodigal and unwary.

But, perhaps, we shall be told, that this is mistaking the object of the usury laws—that they were not intended to force capitalists to lend to spendthrifts at the same rate of interest as to industrious persons, but to protect the prodigal and unwary from the extortion of usurers, by declaring any stipulation between them for more than a given rate of interest to be null and void. But why all this solicitude about the least valuable class of society? Why fetter and restrict the free circulation of capital among those who would turn it to the best account, lest any portion of it might chance to fall into the hands of those who would squander it away? If the prevention of prodigality be an object of sufficient importance to justify the interference of the Legislator, why not at once put the prodigal under an *interdict*? This is the only way in which it is possible to restrict him. It is not so much by borrowing money at high interest, as by contracting debts to merchants, on whose charge there is no check, that spendthrifts generally run through their fortunes. Mr. Bentham has justly observed, that so long as a man is looked upon as one who will pay, he can much easier get the goods he wants than he could the money to buy them with, though he were content to give for it twice or thrice the ordinary rate of interest. How ridiculous is it, then, to stimulate this natural facility of purchasing, to permit prodigals to borrow (for it is really borrowing) the largest supplies of food, clothes, &c. at 20, 30, or even 100 *per cent.* interest, at the same time that we inflict a real injury on every other class of society, rather than permit them to borrow the smallest supply of money at more than 5 *per cent.!* Instead of being of any service, this restriction is evidently injurious to the prodigal. It narrows his choice, and drives him from a market which might have proved much less disadvantageous, to one in which no disgrace attaches to the exaction of the most exorbitant interest, and where he can scarcely escape being ruined.

Neither is the outcry raised against capitalists for taking advantage of the necessities of industrious individuals one whit better founded than that which is raised against them for taking advantage of the extravagant and thoughtless disposition of the prodigal or the simple. According as a person has a character for sobriety, and for punctuality in making his engagements, and according to the presumed state of his affairs at the time, so will he be able to borrow. To say that a capitalist took advantage of the necessities of any individual, is only saying that he refused to lend to a person in suspicious or necessitous circumstances, at the same rate of interest he would have done had he been in high credit; or, which is the same thing, had there been no *risk* of losing the principal; and had he not acted in this manner, should we not have justly considered him as a fool or a madman?

But, as has already been shown, whatever may be the extortion of lenders, the usury laws afford no means of checking it, on the contrary, they compel the borrowers to pay, over and above the common rate of interest, a *premium* sufficient to indemnify the lender for the risk and odium incurred in *breaking them!* They attempt to remedy what is not an evil, and what, consequently, ought not to be interfered with; and in doing this they necessarily create a real grievance. What should we have thought of an act of Parliament to compel the underwriters to insure a gunpowder magazine and a salt warehouse on the same terms? Yet this would not have been in any respect more absurd than to enact that the same rate of interest should be charged on capital lent to those whose security is widely different.

There were no Usury Laws in Holland.

Luckily we are not left to infer from general principles, however well established, the many advantages that would result from a repeal of the laws limiting the rate of interest. The case of Holland furnishes a practical and striking proof of the correctness of the theory we have been endeavouring to establish. It is an undoubted fact, that the rate of interest has been, for a very long period, lower in Holland than in any other country in Europe, and yet Holland is the only country in which usury laws are altogether

Interest.

unknown, where capital is allowed to demand, and borrowers to pay, any rate of interest.* Notwithstanding all the various changes of the government, and the extraordinary derangement of her financial concerns in the course of the last twenty years, the rate of interest in Holland has continued comparatively steady. During the whole of that period, persons who could offer unexceptionable security have been able to borrow at from 3 to 5½ *per cent.*; nor has the average rate of interest charged on capital, advanced on the worst species of security, ever exceeded 6 or 7 *per cent.*, except when the government was negotiating a forced loan.† But, in this country, where the law declares that no more than 5 *per cent.* shall be taken, the rate of interest for capital advanced on the best landed security has, in the same period, varied from 5 to 16 or 17 *per cent.*, or *five* times as much as in Holland. Surely this ought to put to rest all doubts as to the impolicy and the inefficiency of the usury laws.

Legal rate of Interest in France;

In France the usury laws were abolished at the Revolution; and it is distinctly stated, that their abolition *was not attended by any rise of interest.* (Storch, *Economie Politique*, Tome III. p. 187.) According to the *Code Napoleon* only 6 *per cent.* interest is allowed to be taken in commercial affairs, and 5 *per cent.* when money is advanced on the security of real property. There is not, however, any difficulty in evading this law. The method, resorted to for this purpose, is to give a *bonus* before completing the transaction, or, which is the same thing, to frame the obligation for the debt for a larger sum than was really advanced by the lender. None of the parties, particularly interested, can be called to swear to the fact of such a *bonus* being given, so that the transaction is unimpeachable, unless a third party, who was privy to the settling of the affair, can be produced as a witness. The Bank of France never discounts at a higher rate of interest than 5 *per cent.*, but sometimes at a lower rate.

Interest.

In Hamburgh;

In Hamburgh, the rate of interest is quite unrestricted; or, if there be a written law restraining it, it has become altogether obsolete. The rate, therefore, varies according to circumstances. Occasionally it has been at 7, 8, and even 10 *per cent.*; and, in 1799, a period of great mercantile embarrassment and insecurity, it was as high as 14 *per cent.* Generally, however, the rate of discount on good bills does not exceed 4 or 5 *per cent.* (*Report on Usury Laws*, p. 46.)

In Russia;

In Russia the legal rate of interest is 6 *per cent.* But, as Russia is a country capable of much improvement, and where there are very great facilities for the advantageous employment of capital, the market rate of interest is invariably higher than the statute rate, and the law is as constantly as it is easily evaded. (*Ibid.* and Storch, Tome III. p. 207.)

In Austria;

At Trieste, and throughout the Austrian empire in general, the usual rate of interest is fixed by law at 6 *per cent.*; but capital can seldom be obtained for less than 8 or 10 *per cent.* (See *Report ubi supra.*)

In Leghorn;

At Leghorn the ordinary rate of interest is ½ *per cent per* month, or 6 *per cent. per annum*; but there is no law to prevent the taking of a higher rate. (*Ibid.*)

In Spain;

In Spain the ordinary rate of interest is 6 *per cent.*; but no law exists against taking a higher rate, and it seldom falls below 5, or rises above 7 *per cent.* (*Ibid.*)

In the United States.

In the United States legal interest is fixed at 6 *per cent.*, but the market rate fluctuates from 10 to 12 *per cent.* Efforts, Mr Birkbeck informs us, are now making in various parts of the Union, particularly in Virginia and North Carolina, to do away the

* Strictly speaking, this applies only to the state of Holland previously to the Revolution in 1795. The enactments of the Code Napoleon were subsequently introduced; but it appears from the Report of the Parliamentary Committee on the Usury Laws, that they have not, in any instance, been acted upon.

† The general rate of discount in Holland is from 4 to 5 *per cent.*, and occasionally from 3 to 3½ *per cent.*, but very seldom lower. During the Revolution it has been at 6 and 7 *per cent.*, and even at 8, but this has been generally owing to some *forced financial operation* on account of the government, and has never been of long duration. The following is the average rate of discount at Amsterdam and Rotterdam from 1795 to 1817:

1795—4,	4½,	5,	6,			
1796—4,	4½,	5,	6,			
1797—4,	4½,	5,	5½,	6,	9,	12,
1798—4,	4½,	5,	5,			
1799—3,	4,	4½,	5,			
1800—4,	4½,	5,	6,			
1801—4,	4½,	5,	6,			
1802—4½,	5,	5½,	6,			
1803—4,	5,	5½,	6,			
1804—4,	4½,	5,	5½,	6,		
1805—4,	5,	5½,	6,	9,		
1806—4,	4½,	5,	5½,	6,	9,	
1807—4,	4½,	5,	6,			
1808—4,	3½,	4½,	5,	6,		
1809—4,	4½,	5,	6,			
1810—4,	4½,	5,	6,			
1811—3,	3½,	4,	5,			
1812—3,	3½,	4,	5,			
1813—3,	3½,	4,	5,	6,		
1814—4,	5,	5½,	5,	6,	6½,	
1815—5½,	6,	6½,	7,			
1816—5,	5½,	6,	6½,	7,		
1817—5,	5½,	6,				

"The Bank of Amsterdam never discounts at a higher rate than 5 *per cent.*; but they discount at a lower rate, and vary their discounts according to the abundance of capital, never exceeding 5 *per cent.*, and occasionally as low as 2½ and 3."—Mr Holland's evidence, *Report of the Committee on the Usury Laws.*

restraints on usury, which, as he justly observes, "*operate merely as a tax on the needy borrower.*"—(*Letters from Illinois*, p. 36.)

Usury Laws do not reach the Government.

If usury laws are to have any existence, they ought certainly to be made to operate on the greatest of all borrowers—on those who do not borrow on their own credit, but on that of others. Is it not the extreme of folly, that, while an industrious manufacturer, or agriculturist, is prevented from giving more than 5 *per cent.* for capital, which he might be able to invest so as to yield 10 or 12 *per cent.*, Government should be allowed to borrow at 6, 8, 10, or 20 *per cent.*? What is this but holding out a bait to loan-mongers, and causing the capital of the country to flow with an accelerated and unnatural velocity into the Treasury? Nothing surely can be more impolitic than this. If we are to have usury laws, they ought to operate alike on every class of borrowers; and, considering the superior attractions which the facility of repossessing the principal gives to the investment of capital in the funds, the rate of interest at which Government should be allowed to borrow, should be *less* than the rate at which private individuals might borrow.

We trust, however, that we have said enough to show the inexpediency and the pernicious tendency of all such regulations. If a landlord is to be allowed to take the highest rent he can get offered for his land—a farmer the highest price for his raw produce—a manufacturer for his goods—why should a capitalist be restricted and fettered in the employment of his stock? Every principle of natural justice, and of sound political expediency, is outraged by such a distinction.

The present a particularly fit period for abolishing the Usury Laws.

So long as the market rate of interest continued higher than the statutory rate, it cannot be doubted that considerable inconvenience would have resulted from any *sudden* abolition of the usury laws. It is certain, indeed, that this inconvenience would have been very speedily compensated by the check which the abolition would have given to the traffic in annuities, and by the easier circulation and more advantageous distribution of capital. Now, however, when the market is fallen below the statutory rate of interest, no inconvenience could attend their repeal. It could not lead to any demand for payment of borrowed money, for no individual would require payment of what he could not relend to greater advantage. But, while their repeal would be in no respect disadvantageous, it would enable those who are engaged in employments of more than ordinary hazard, to procure adequate supplies of stock on more favourable terms; and it would also secure us against the risk of future mischief should the market again rise above the legal rate of interest. It is unnecessary, however, to urge the *immediate* repeal of the usury laws. We think it quite visionary to apprehend any danger from the instant application of a sponge to the whole of the anti-usurious statutes, but it is enough if they are repealed *gradually*. To avoid exciting any alarm in the minds of the most timid, the rate at which capital may be legally lent at interest might be annually raised *one*, or *one-half per cent*, until the rate had been extended to 8 or 10 *per cent.*, when it is clear every restrictive regulation might be abolished, without the possibility of the smallest derangement happening in consequence.

Were the usury laws abolished, it would be proper to frame a statute which should fix the interest to be paid in those cases in which no previous agreement had been made respecting it. But as, in cases of this description, there is very frequently considerable doubt whether it was the intention of the parties at the time the transaction took place, that any interest should be charged; it would be proper to give the borrower the full benefit of this doubt, by fixing the rate payable in such cases at the lowest market rate.

Error of some writers on the subject of a low rate of Interest.

Before concluding we may remark, that, until the laws regulating the rate of profit and the increase of capital had been accurately investigated, the great wealth and commercial prosperity of Holland was invariably appealed to as a practical proof of the advantages of a low rate of interest. But Sir Josiah Child, and those who have insisted so much on this example, forget that the lowness of interest in Holland was the necessary effect of the circumstances in which that country was placed,—of the lowness of profits, caused by the oppressiveness of taxation, and the deficient supply of fertile soil, and not of any *interference* on the part of the Government. Neither was this lowness of interest any advantage, but a positive disadvantage. A country, whose average rate of profit, and consequently of interest, has been reduced considerably below the level of surrounding nations, may, notwithstanding, abound in wealth, and be possessed of an immense capital, but it would be the height of error to suppose, that this reduction of profits and interest could have facilitated their accumulation. Capital cannot be accumulated otherwise than by a saving of income, and wherever incomes are large, and this will always be the case where the rate of profit is comparatively high, there must be a proportionably increased facility of gratifying the prevalent passion for accumulation. The case of Holland, far from contradicting, furnishes a striking example of the truth of this principle. Sir William Temple mentions, that her trade was rather on the decline in 1670; and the large capital of which she was then in possession had been accumulated previously to her wars with Cromwell, and when the rate of profit was much higher than at any subsequent period. Low profits are a certain proof that society has become clogged in its progress. They show, that it is approaching, if it has not already reached, the stationary state, and that, unless measures can be devised for relieving the pressure on the resources of the state, it will be thrown back in the career of improvement, and outstripped by its neighbours. The rate of profit, and the rate of interest, are ordinarily twice as high in the United States as in Great Britain or France, and it is to this that the more rapid advancement of the former in wealth and population is entirely to be ascribed. High profits, it is true, may not, in every instance, be accompanied by a great degree of prosperity; for, a despotic government, or the want of sufficient protection, may paralyse all the efforts of those who are otherwise placed in the most favourable circumstances for the accumulation of wealth. But, *if the*

Interest || Inverness-shire.

government be equally liberal, and if property be equally well secured, the degree of national prosperity will be correspondent to the rate of profit. The demand for labour, or which is, in effect, the same thing, the funds for supporting the largest and most valuable portion of society, increase or diminish in exact proportion to the increase or diminution of profits. Wherever they are high, the labourer is well paid, and the society rapidly augments both its population and its riches: on the other hand, wherever they are low, the demand for labour is proportionably reduced, and the progress of society rendered so much the slower.

Instead, therefore, of a low rate of profit, and a low rate of interest, for the one must be always directly as the other, being any proof of the flourishing situation of a country, it is distinctly and completely the reverse. High profits show that capital may be readily and beneficially invested in the different branches of industry, and wherever this is the case, it will be better for the borrower to pay a high rate of interest than it would be for him to pay a lower rate, in countries where there is less facility of employing his stock with advantage. The borrower who pays 10 or 12 *per cent.* for capital in the United States, generally makes a more profitable bargain than the English borrower who pays only 4 or 5 *per cent.* It is obviously not by the circumstance of the rate of interest payable on loans being absolutely high or low, but by the proportion between that rate and the average rate of profit, that we must determine whether they have been obtained on favourable or unfavourable terms. (s. s.)

Situation and extent. INVERNESS-SHIRE, the most extensive county in Scotland, situated between 56° 40′ and 57° 36′ north latitude, and between 3° 50′ and 5° 50′ west from Greenwich, is bounded on the north by the shires of Ross and Cromarty; on the east by Aberdeen, Banff, Moray, and Nairn, and by the Moray Frith; on the south by Perth and Argyle; and on the west by the Atlantic Ocean. It is from 50 to 75 miles in length; in breadth from 30 to 50 miles; and its area is computed to be 3036 square miles, of which the space occupied by lakes has been estimated at 132 miles, and the land at 2904, or 1,858,560 English acres.

Boundaries. The exterior outline of this county is exceedingly irregular. On the north-east, where the county town is situated, a narrow tract runs out between Nairnshire and the Moray Frith; farther to the east, a portion of it is detached and inclosed by the counties of Moray and Banff, Argyleshire penetrates into it from the south-west; and on the west it is indented by lochs Moydart, Aylort, Nevish, Hourn, and other arms of the sea.

Surface. The surface is still more varied, consisting of ranges of lofty mountains, alternating with deep narrow vallies, the beds of a great many lakes and rivers. The most prominent feature is Glenmore, or the Great Glen, for the most part a mile in breadth, and bounded on either side by precipitous high grounds, which traverses the county from south-west to north-east, dividing it into two nearly equal parts. Great Valley. In this glen, from north to south, are Loch Ness, Loch Oich, and Loch Lochy, which, when united by a canal of about 22 miles (see CALEDONIAN CANAL in this *Supplement*), will form a line of inland navigation between the east and west seas, or from the Moray Frith, on the north-east, to Linnhe Loch, an arm of the Atlantic, on the south-west, a distance of about 60 miles, for frigates of 32 guns, and vessels of 600 tons. Loch Ness is remarkable for never freezing, a circumstance ascribed to its great depth, and for its waters having been violently agitated during the great earthquake at Lisbon in November 1755. On each side of this valley there is a number of glens and straths, separated by mountainous ridges: with lakes which receive the waters from the high grounds, and discharge them by outlets, partly into the lakes in the central valley, and partly, by a more direct course, into the arms of the Atlantic on the west, or by rivers which flow from this county into the counties on the east, and thence into the German Ocean.

Divisions. The western side, or the country between the great valley and the Atlantic, from Argyleshire on the south to Ross-shire on the north, a distance of about 70 miles, is the most wild and mountainous tract of Inverness-shire, and is therefore known by the name of the *Rough Bounds;* yet before reaching the sea coast, the general elevation is somewhat diminished. In this tract, beginning at the south, the principal divisions are Moydart, Arasaig, Morrer, Knoydart, and Glenelg, which contain a variety of glens or vallies, among which are Glengary, Glen Moriston, Glen Urquhart, and Strathglass. Glens and Lochs. The most considerable lakes in this quarter are Loch Eil, Loch Shiel, Loch Arkeg, Loch Gary, and Loch Maddy. Lochan Uain, in the parish of Kilmorack, about 40 miles west from Beauly, is said to have been known to remain frozen all the year through. On the east side of the valley lies the extensive district of Badenoch; at its southern termination is Lochaber; and at its northern the Aird, the most fertile part of the county. These divisions also comprise a great many glens, lakes, and rivers, extensive woodlands, and not a little productive land. The principal vallies here are Glenroy, noted for its parallel roads, which it is now agreed must have been formed by the gradual subsidence of the waters, and not by the hand of man, Strathspey, Stratherrick, Strathearn, and Strathnairn. Treig, Ericht partly in Perthshire, Laggan, Insch, and Moy, are the names of the most considerable of the lochs in this quarter; and here the Spey, the Findhorn, and the Nairn, and a number of smaller streams, have their source.

Moors and Mountains. The general aspect of Inverness-shire may be further conceived, when it is stated that two-thirds of the surface is covered with heath; only a fortieth part corn land; and that the corn land, woodlands, and green pastures, together, do not exceed eight acres in an hundred. In many large tracts, heath prevails to such a degree that, for twelve or fifteen miles, scarcely any verdure is to be seen, except

Inverness-shire.

where a solitary rivulet has occasionally overflowed its banks. On the south of Badenoch, there is a flat of deep moss, supposed to be the most extensive in Britain, in which a great number of small lakes are interspersed, some of them containing wooded isles, where the deer, from the inaccessible nature of the ground, find shelter from their pursuers. But the far greater part of the county is occupied with mountains. Ben-Nevis, 4380 feet high, stands on the south-west, a little to the east of the Caledonian Canal; Meal Fourvounie, on the west of Loch Ness, is more than 3000 feet high; and Cairngorm, partly in Banffshire, upwards of 4000. It has been remarked, as a singular circumstance, that several of the hills, which are covered with heath on the sides, are green on the summit, and produce valuable pasturage.

Productive Land.

The productive land lies chiefly on the sea coast, and along the banks of the lakes and rivers; much of it in the latter situation is alluvial and fertile: there is also clay in a few places; but the prevailing soil is sand, or a sandy loam, well adapted to the growth of barley, potatoes, turnips, and other green crops.

Rivers.

The principal rivers of Inverness-shire are the *Spey*, which rises from a loch of that name a little to the east of the Great Valley, and flowing in a course from south-west to north-east for about 96 miles, falls into the sea, about eight miles east of Elgin, in Morayshire, carrying with it the waters of 1300 square miles; the *Ness*, which issues from Loch Ness, and, flowing through the town of Inverness, falls into the Moray Frith, after a course of six miles; the *Lochy* issues from Loch Lochy, and has a course of ten miles westward, till it falls into Loch Eil, near Fort-William; soon after it leaves its parent lake it is joined, from the east, by the *Spean*, which is remarkable for being crossed by a bridge, two of the arches of which are 95 feet high; and the *Beauly*, which has its source in the north-west, and carries the united waters of the Glass, and other two rivulets, into the Frith of the same name. The *Findhorn* and *Nairn* on the east, and the *Garry* and the *Morriston* on the west, are smaller streams. The *Foyers*, which flows into Loch Ness from the south, is remarkable for its celebrated falls, one of which, according to Dr Garnet, is 70 feet, and the other half a mile lower, 212. There are cascades not inferior to these in the parish of Kilmorack, on the waters which unite to form the Beauly, and at Loch Leven head, in the southern quarter; near which last place there are also some remarkable caverns.

Minerals.

Granite, limestone, slate, marble, brick-clay abound in many parts of Inverness-shire; lead has been discovered in Ben-Nevis, and at three other places in that neighbourhood, and also at Glengary, but none of it is wrought. A vein of plumbago has been found in Glengary. A great part of the mountain Ben-Nevis is composed of beautiful porphyry. There is no coal, and for want of it much of the limestone is of little value.

Woods.

From the trees found in great numbers, and some of them of a remarkable size, in all the mosses, there is reason to believe that this country was, at an early period, almost covered with wood; and at present there is a greater space covered with natural pines here than in all the rest of Britain. In Strathspey, it is said that three tiers of stocks have been found, directly above one another, in a moss, from which it is inferred that the deepest must have come to maturity, and been destroyed, before the one next above it was formed. In the same district, there are about 15,000 acres of natural firs, besides 7000 of planted firs and larches; and the natural woods on Loch Arkeg, in Glengary, Glenmoriston, Strathglass, Glen Strathfarrer, and at the head of Loch Shiel, are also very extensive. Full grown trees of ash, lime, beech, oak, plane, and mountain-ash, are found at Castle Grant, Culloden, and Belladrum, in the northern quarter of the county; but in most other places, the woods are in the state of coppice. The birch is in great abundance on the sides of Loch Ness, Loch Laggan, about Rothiemurchus, and in the vale of Urquhart. Part of the great Caledonian Forest extends for several miles near the boundary of this county with Perthshire. Considerable tracts have been planted, chiefly with firs and larches, particularly in the north-east, where the county town is situated, in Badenoch, and on Loch Eil.

Fisheries.

There are several fishing villages on the east coast, yet the sea-fishery is not prosecuted to a great extent, partly owing, it is alleged, to the regulations of the Salt Laws. But the arms of the sea, and the numerous lakes and rivers, afford an abundant supply of fish. The herring occasionally visits Loch Eil; salmon yield a considerable rent on the rivers Lochy, Beauly, and Ness, and are found also in the Morrer, in Loch Insch in Badenoch, and at Invermoriston. Char is caught in several of the lochs, and flounders and sprats in the Beauly.

Wild Animal

The moors and woodlands are plentifully stocked with game,—red and roe deer, the Alpine and common hare, black game and ptarmigan, grouse, partridges, &c.; and pheasants have been lately introduced. Foxes and wild cats are still numerous, and in the lakes and rivers, otters. There are also eagles, hawks, and owls; and a multitude of water fowls, particularly swans, resort to Loch Insch, and the other lakes of Badenoch.

Estates

The territory of Inverness-shire is divided into estates of great extent, and, in proportion to the rental of the county, of great value. In 1804 more than the half, if we may judge from the old valuation, belonged to seven proprietors, and as much more was held by other six, as made the possessions of these thirteen individuals equal to more than two-thirds of the whole, each of them at a medium must, therefore, have contained about 100,000 acres. In 1811, the number of estates was seventy-seven, of which fifty-seven were below L.500 Scots of valuation.

Proprietors.

The greatest proprietors are the Duke of Gordon, the Earl of Moray, Lord Macdonald, Lord Cawdor, Macleod, Fraser of Lovat, Sir James Grant, Grant of Rothiemurchus, Mackintosh, Cameron of Locheil, Macniel, Macpherson, Chisholm, Macdonell of Glengary, Macdonald of Clanranald, Baillie of Duff, and Forbes of Culloden, most of whom have seats in the county.

Valuation and Rental

The valuation taken in 1601 is L.73,188, 9s. Scots, and in 1811, the real rent of the lands was L.195,843, 15s. Sterling, and of the houses, L.9235, 2s. Sterling. The old valuation of the whole of Scotland,

Inverness-shire.

as fixed about the middle of last century, and which is still the rule by which county assessments are imposed, is to the actual rent of the lands alone in 1811, as L.1 Scots is to L.1.265 Sterling; whereas in this county, rents have risen in so much greater a proportion than in the rest of Scotland, chiefly perhaps owing to the introduction of sheep-farming, that its valuation is to its actual rent only as L.1 Scots is to L.2.675 Sterling; and it is worthy of remark, that this rise cannot be ascribed in any considerable degree to the outlay of capital by proprietors, in building or otherwise, as in most other parts of Scotland.

Rural Economy.

Of the occupiers of the land,—tacksmen, small tenants, and cottars—of the size of the farms, and of the rural economy of the county generally, we have little to say in addition to what we have already offered under the Highland counties of Scotland in the preceding part of this *Supplement*. Small spots of corn-land contiguous to the hamlets, of which the alternate ridges or lands belong to different cultivators, who used to interchange their allotments once a year, and more recently, only once in three years; a larger space of *outfield* beyond this, part of which is constantly cropped till it is exhausted, and then left to nature, when another part, which had been treated in the same manner, but which has been somewhat restored in the mean while by the folding of cattle, takes its place; and beyond this outfield, separated from the higher grounds by a *head dike*, large tracts of common pasture;—these, with their miserable huts, their irregular and always inefficient labour, their indolence, their poverty, present a striking picture of what must have been the condition of the great body of the people of Scotland during the feudal ages; and which is not now, as it was then, somewhat relieved by hospitality and protection on the one side, and respect, gratitude, and attachment, on the other.

This system, indeed, has been gradually approaching to its termination for the last thirty years, and in some parts of Inverness-shire it exists no longer in its original form. The change has been chiefly effected by the introduction of sheep, which has occasioned so many complaints, and probably much real suffering for a time to many individuals; but which is likely in the end to be most advantageous to the public at large. With respect to its effect on population, one main topic of declamation, it has not been such as its opponents allege; for the population of Inverness-shire, any more than of the Highlands in general, has not diminished. On the contrary, its increase in this county, from 1755 to 1811, has been much greater than in Haddingtonshire and the other merely agricultural districts of Scotland. Within that period, it has increased from 64,656 to 78,336, or upwards of 21 *per cent.* while that of all Scotland has been no more than 44 *per cent.*; and it is well known that the far greater part of this apparently general increase has been occasioned by the extension of manufactures and commerce, and is chiefly confined to a few districts.

Trade.

The principal exports are cattle, sheep, wool, timber, and slates. The corn grown in the county, chiefly bear or big, and oats, and only on the east coast wheat, is all consumed within itself, much of the bear in illicit distillation; as well as all the potatoes, the most important article of food for the greater part of the year; and the products of the dairy. It imports coals, lime, flour, oatmeal, groceries, and other articles of domestic consumption.

Manufactures.

The manufactures are, bagging from hemp, thread, kelp to a considerable extent on the west coast, with some tiles and bricks. There are also tan-works, breweries, bleachfields, and an iron-foundery; and some attempts have been made at different periods to carry on branches of the woollen manufacture.

Towns and Villages.

Inverness, the capital of the Highlands, a royal burgh, and the only town of any extent in the county, is situated on both sides of the river Ness, at its entrance into the Moray Frith. It is a place of great antiquity, but it is only since the middle of the last century that it has made regular advances to its present prosperity. Nearly all the trade and manufactures of the county are carried on here, and it is favourably situated for becoming a place of general resort for the northern counties, of which it is considered the metropolis. The population, in 1811, was 11,353. From the west sea, a few vessels come up to Fort-William, from which the exports are wool, skins, herrings, kelp, and slates. The most considerable village is Maryburgh, or Gordonsburgh, near Fort-William. Grantown is a neatly built village on the great road along the Spey, which, under the auspices of Sir James Grant, the proprietor, has made considerable progress. It contains a town-house and prison, with a well endowed school, and a few years ago a factory was begun for carding and spinning wool, and for making blankets and woollen cloths.

Fairs.

Fairs are held for the sale of cattle, sheep, and wool, at Fort-William, Beauly, Grantown, and Kingussie, and four in the year in Inverness, where there is also a well supplied market every Tuesday and Friday.

Roads.

An easy communication is now formed throughout the greater part of the county by means of the roads made under the direction of the *Parliamentary Commissioners for Highland Roads and Bridges*, half the expense of which is borne by the county, and the other half is granted by Parliament.

Antiquities.

Among the antiquities of Inverness-shire, which we can only notice generally, are the circles of stones ascribed to the Druids, which are found in many parts of the county, particularly at Corrimony in its northern quarter; two artificial mounts in the parish of Petty, supposed to have been places for administering justice; round buildings, called Picts' Houses, in Glenelg, and other parts; forts, built without mortar, one of which, called Castle Spynie, two miles east from the church of Beauly, incloses a circle of 54 yards, and another in the parish of Laggan, stands on a rock, 100 yards in perpendicular height; vitrified forts on the hill of Craig Phadric, about two miles from Inverness, Dundhairdghall in Glen Nevis, and Dun Thion near the river Beauly; and a variety of castles, of which Inverlochy Castle, a building of great extent, and unknown antiquity, on the banks of the Lochy near Fort-William, is, perhaps, the most remarkable. On a hill near Inverness, called the Castle Hill, stood

Inverness-shire. the castle of the Thane of Cawdor, where Macbeth is said to have murdered Duncan. It was razed by Malcolm Kenmore, who removed the town to the northward, where it now stands, granted its first charter, and built a fortress on the site of the old town, which was repaired in 1715, and finally demolished in 1765. Cromwell erected a citadel at the mouth of the river Ness, which was demolished by Charles II.

Forts. The chain of forts along the line of the Caledonian Canal has been already noticed. (See INVERNESS-SHIRE in the *Encyclopædia.*) *Fort-George* is a regular fortress, mounting 80 guns, with barracks for 3000 men, which was begun in 1747, and completed in 20 years, at an expence of about L.160,000. It is situated 11 miles eastward from Inverness, upon a neck of land on the Moray Frith, opposite to Fortrose in Ross-shire. *Fort-Augustus*, also a regular fortification, though a place of no great strength, with four bastions and barracks for 400 men, is situated at the west end of Loch Ness, nearly midway between the east and west seas. It was first built in 1730 at some distance from Loch Ness, but having been demolished by the rebels in 1745, it was afterwards rebuilt nearer the lake. *Fort-William*, built in the reign of William III., is situated on a navigable arm of the sea, called Loch Eil, at the south-western termination of the great valley. Part of it is now in ruins, but it is still occupied by a company of invalids. On Culloden Moor, a level heath to the eastward of Inverness, on the 16th April 1746, was fought the battle which put an end to the rebellion of 1745; the greater part of this heath is now covered with plantations.

Parishes. Inverness-shire contains twenty-eight entire parishes, and shares other four with the counties of Argyle, Nairn, and Moray. Of these, twenty are on the mainland, and the remainder in its islands. Some of the parishes on the mainland, as well as in the islands, would form a square of 20 miles each. Kilmalie and Kilmorack are still larger, extending in length about 60 miles, and in breadth almost 30. Many of the inhabitants are Roman Catholics, particularly in the districts of Moydart, Arasaig, Morrer, and Knoydart, on the west side. The county sends one member to Parliament, and the town of Inverness, along with Forres, Nairn, and Fortrose, choose one for the burghs. The Sheriff holds courts at four places, two of which, Inverness and Fort-William, are for the mainland, and two more for the isles in Skye and Long Island. The population of the whole shire in 1800 and 1811 is given in the annexed table.—(See the *Statistical Account of Scotland*, and Playfair's *Description of Scotland*; Robertson's *Survey of Inverness-shire*; *The Beauties of Scotland*, Vol. V., and the *General Report of Scotland*.) (A.) Representation. Population.

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
14,357	15,353	159	33,801	40,491	34,068	3864	36,361	74,292

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
14,646	16,014	215	35,722	42,614	9594	3294	3126	78,336

IODINE. See CHEMISTRY, in this *Supplement*, p. 15.

JOINERY.

Is one of the useful arts which contributes most materially to the comfort and convenience of man. As the arts of joinery and carpentry are often followed by the same individual, it appears, at first view, natural to conclude, that the same principles are common to both these arts. But a closer examination of their objects leads us to a different conclusion.

Carpentry defined.

The art of Carpentry is directed almost wholly to the support of weight or pressure; and, therefore, its principles must be found in the mechanical sciences. In a building, it includes all the rough timber-work necessary for support, division, or connection; and its proper object is to give firmness and stability. See the Article Carpentry in this *Supplement*.

Joinery defined.

The art of Joinery has for its object, the addition in a building of all the fixed wood-work necessary for convenience or ornament. It is the *Intestinum opus* of Vitruvius; and the *Menuiserie de bâtimens* of the French.

The joiner's works are, many of them, of a complicated nature, and require to be executed in an expensive material; therefore joinery requires much skill in that part of geometrical science which treats of the projection, and description of lines, surfaces, and solids, as well as an intimate knowledge of the structure and nature of wood.

It may also be remarked, that the rough labour of the carpenter renders him, in some degree, unfit to produce that kind of accurate and neat workmanship which is expected from a modern joiner.

Progress of Joinery in England.

In early times, very little that resembles modern joinery was known; every part was rude, and joined in the most artless manner. The first dawnings of the art appear in the thrones, stalls, pulpits, and screens, of our cathedrals and churches; but, even in these, it is of the most simple kind, and is indebted to the carver for every thing that is worthy of regard. Whether, in these monuments, the carver and the joiner had been one and the same person, we cannot now determine, though we imagine, from the mode of joining in some of them, that this was the case.

During several centuries joinery seems to have been gradually improving, but nothing appears to have been written on the art before 1677, when Mr Joseph Moxon, a Fellow of the Royal Society, published a work, entitled *Mechanick Exercises*, or the *Doctrine of Handyworks*. In this work the tools, and common operations in joinery, are described, with a collection of the terms then in use. It must have been a valuable work at that time, but to a master in the art it would convey little if any thing that was new. Sash-windows were introduced into England some time before the date of Moxon's work, but he has not noticed them. According to the observations of Dr Thomson, this important improvement has not yet found its way into Sweden. (*Travels in Sweden*, p. 8.)

Joinery.

About the beginning of the last century, several works of a most interesting kind made their appearance. Forms began to be introduced in architecture which could not be executed, at a moderate expense, without the aid of new principles, and these principles were discovered and published by practical joiners. As might naturally be expected, these authors had but confused notions, with a scanty portion of geometrical knowledge; and, accordingly, their descriptions are often obscure, and sometimes erroneous.

The hand-rails of stairs offered many difficulties, and an imperfect attempt to remove them was first made by Halfpenny, in his *Art of Sound Building*, published in 1725. Price, the author of the *British Carpenter*, published in 1733, was more successful, and his remarks show a considerable degree of knowledge of the true nature and object of his researches.

The publication of Price's work must have produced a considerable sensation among joiners, for it was soon followed by many other works of different degrees of merit. Of these the works of Langley and Pain were the most popular.

The establishment of the principles of joinery, on the sound basis of geometrical science, was reserved for Nicholson. In his *Carpenters' Guide*, and *Carpenter and Joiners' Assistant*, published in 1792, he has made some most valuable corrections and additions to the labours of his predecessors.

Corresponding improvements were also made in the practice of joinery, for which we are much indebted to the late Mr James Wyatt. This celebrated architect kept together some of the best workmen in London, who were looked up to with a degree of emulation by young men, which had a beneficial effect on the progress of joinery. But the art is still far short of perfection. We conceive that many of those operations, on which the soundness of work chiefly depends, might be done with greater exactness, and less labour, by means of tools contrived for these purposes. The truth and certainty which have been introduced in block-making, is sufficient to encourage some one to extend the same manner of mortising to joinery. (See Block-Machinery in this *Supplement*.)

Progress of Joinery in France.

The principles of joinery were cultivated in France by a very different class of writers. In the extensive work of Frezier, entitled *Coupe des Pierres et des Bois*, 3 Vols. 4to. 1739, all the leading principles are given and explained with tedious minuteness; offering a striking contrast to the brevity of our English writers. The first elementary work on that part of geometrical science, which contains the principles of joinery, appeared in France, in 1795, from the pen of the celebrated Gaspard Monge,

who gave it the name of *Géometrié Descriptive*. Much of what has been given as new in English works, had been long known on the Continent; but there does not appear to have been much, if any, assistance derived from these foreign works by any writer prior to Nicholson.

The latest French work which treats of joinery is Rondelet's *L'Art de Bâtir*. It is also the best foreign work on the subject that we have seen; but it is not at all adapted to the state of joinery in England. In practice, the French joiners are very much inferior to our own. Their work is rough, slovenly, and often clumsy, and at the best is confined to external effect. The neatness, soundness, and accuracy, which is common to every part of the works of an English joiner, is scarcely to be found in any part of the works of a French one. The little correspondence, in point of excellence, between their theory and practice, leads us to think that their theoretical knowledge is confined to architects, engineers, &c. instead of being diffused among workmen, as it is in this country.

In cabinet-work the French workmen are certainly superior, at least as far as regards external appearance. But when use, as well as ornament, is to be considered, our own countrymen must as certainly carry away the palm. The appearance of French furniture is much indebted to a superior method of polishing, which is now generally known in this country.* For many purposes, however, copal varnish (such as coachmakers use) is preferable; it is more durable, and bears an excellent polish.

Geometrical knowledge necessary.

Geometry is useful in all, and absolutely necessary in some, parts of a joiner's business: but it is absurd to encounter difficulties in execution, and to sacrifice good taste, convenience, economy, and comfort, merely for the purpose of displaying a little skill in that science. It is, however, a common fault, among such architects as are better acquainted with geometrical rules than with the production of visible beauty, to form designs for no other purpose than to create difficulties in the execution.

But, when geometrical science is properly directed, it gives the mind so clear a conception of the thing to be executed, that the most intricate piece of work may be conducted with all the accuracy it requires.

Practice of Joinery.

The practice of joinery is best learned by observing the methods of good workmen, and endeavouring to imitate them. But the sooner a workman begins to think for himself the better; he ought always to endeavour to improve on the processes of others; either so as to produce the same effect with less labour, or to produce better work.†

We intend, in this article, to give a plain and simple exposition of the most valuable principles of the art of joinery, which will, we hope, place many parts of the practice under a new point of view, and ultimately tend to improve them.

Cabinet-Making.

Cabinet-making, or that part of the art of working in wood which is applied to furniture, has little affinity with joinery, though the same materials and tools be employed in both. Correctness, and strict uniformity, are not so essential in moveables as in the fixed parts of buildings; they are also more under the dominion of fashion, and therefore are not so confined by rules as the parts of buildings.

Cabinet-making offers considerable scope for taste in beautiful forms, and also in the choice and arrangement of coloured woods. It requires considerable knowledge in perspective, and also that the artist should be able to sketch with freedom and precision.

If the cabinet-maker intend to follow the higher departments of his art, it will be necessary to study the different kinds of architecture, in order to make himself acquainted with their peculiarities, so as to impress his works with the same character as the rooms they are to furnish.

In as far as regards materials, and the principles of joining work, the cabinet-maker will find some useful information in the second and third sections of this article. In ornamental composition, he may derive much benefit from Tatham's *Etchings of Ancient Ornamental Architecture*, London, 1799; Percier et Fontaine's *Recueil de Décorations Intérieures comprenant tout ce qui a rapport à l'Ameublement*, Paris, 1812; and, for general information, the *Cabinet Dictionary*, and the *Cabinet-Maker and Upholsterer's Drawing-Book* of Sheraton, may be consulted.

Sect. I.—On making Working Drawings.

1. In this section we propose to lay before the reader the most important part of the principles of describing, on a plane surface, the lines necessary for determining bevels, forming moulds, or any other purpose required in the practice of joinery. The limits, within which such an article as joinery must be confined, in a work like this, will not permit us to enter much into detail on the various points to be illustrated in this section; but we hope, by judicious selection, to place under one point of view the principles that are most useful to the joiner.

Projection of Bodies.

Nature of Projection illustrated.

2. A clear idea of the nature of projection is so essential in making working drawings, that, in our endeavours to illustrate it, we cannot proceed from principles too simple. In the first stage of such an inquiry, experiment furnishes at once the most clear and satisfactory evidence, particularly to those who are not familiar with mathematical subjects.

If some small pieces of wood, or pieces of wire,

* The method of making and using the French polish is minutely described in Dr Thomson's *Annals of Philosophy*, Vol. XI. p. 119 and 371.

† Descriptions of the tools, with instructions for using them, may be found in Moxon's work before quoted, and in Nicholson's *Mechanical Exercises*, Taylor, London, 1812.

Joinery.

were joined together, so as to represent the form of a solid body, a cube for example, and if this figure were held between the sun and the surface of a plane board, then the shadow of the figure upon the board would be its projection upon that plane. From this simple experiment, it will appear, that the projection of any line placed in the direction of the sun's rays will be a point: the projection of any line parallel to the plane will be of the same length as the line itself, and the projection of any line inclined to the plane will be always shorter than that line.

3. We have supposed the board to be placed at any angle with the direction of the rays of the sun; but, for our present purpose, it is sufficient to consider them to fall perpendicularly upon it; hence it is obvious, that to project a straight line upon a plane, a perpendicular to the plane should be let fall from each end of the line, and the line joining the points where the perpendiculars meet the plane will be the projection required.

When a projection is made upon a horizontal plane, it is usually called a *plan* of the body. When the projection is upon a vertical plane, it may be an *elevation* or a *section* of the body; it is a section when a portion is supposed to be cut off; and the plane of projection is usually parallel to the plane of section.

4. Bodies may be divided into three classes, according to the kinds of surfaces by which they are bounded. The first class, comprehending those which are bounded by plane surfaces, such are cubes, prisms, pyramids, and the like. The second class contains those which are bounded in part by plane surfaces, and the rest by curved surfaces, as cylinders, cones, &c. The third, including those which are bounded by curved surfaces only, as spheres, spheroids, &c.

The projections of the first class of bodies will consist of straight lines; those of the second class, of curved as well as straight lines; and those of the third class, of curved lines only.

Projection of Lines.

5. Let ABCD, and CDEF, Fig. 1, Plate LXXXVI. be two plane surfaces, connected by a joint at CD, so that while the plane CDEF remains horizontal, the plane ABCD may be placed perpendicular to it, and thus represent a vertical plane. Then, if a line be so placed in space, that ab is its projection on the vertical plane, and $a'b'$ its projection on the horizontal plane, its projection on any other vertical plane, HGEC, may be determined. This is easily effected, for we have seen, that if a perpendicular be drawn to the plane from each end of the given line, they will give the positions of the ends of the line in the projection (Art. 3). Now, the same thing will be done, by drawing $a'a''$ and $b'b''$ perpendicular to EC, and setting off the points a'' and b'' at the same height above EC respectively, as a and b are above CD, then the line $a''b''$ is the projection required.

The heights may be transferred from one vertical plane to another when they are both supposed to be laid flat, by drawing the line IC, so as to bisect the angle ECD, and if cb be parallel to CD, meeting IC in c, then a line drawn parallel to EC, from the point c, will give the height of the point b'', and so may be found the height of any other point.

6. In the particular case we have drawn, none of the projections represents the real length of the given line. To obtain this length, draw $a'e$ parallel to CD, and with the radius ab' describe the arc $b'e$ cutting $a'e$ in e; draw de perpendicular to CD, cutting the line cb in d; join ad, and it is the length of the given line.

To determine the length of a Projected Line.

The real lengths of lines frequently are not given, therefore another general method of finding them will be found useful, and which may be stated as follows: the length of an inclined line projected upon a plane is equal to the hypothenuse of a right-angled triangle, of which one side is the projection upon the plane, and the other side is the difference between the perpendicular distances of the extremes of the line from the plane.

Projection of Planes.

7. In Fig. 2, $a'b'cd$ represents the horizontal projection, or plan, of a rectangular surface, and the elevation ab shows its inclination; and its projection against another vertical plane, making any angle ECD with the former, or plane of elevation, is shown by $a''b''c'd'$. GC being perpendicular to EC, and AC perpendicular to CD, the heights may be transferred by means of arcs of circles described from C as a centre. This is a better method than that by bisecting the angle given in fig. 1; but neither of them so good, in practice, as setting of the heights with the compasses, or with a lath. In our figures it is desirable to show the connection of corresponding parts as much as possible; therefore, the reader will bear in mind that many of the operations we describe may be done with fewer lines when the operator is fully master of his subject.

8. It may be further noticed in this place, that when a point is to be determined in one line, by the intersection of another, the lines should cross each other as nearly at right angles as possible; for, when the intersecting lines cross very obliquely, a point cannot be determined with any tolerable degree of accuracy.

Projection of Curved Lines.

9. A curved line can seldom be projected by any other means than by finding a number of points through which the projected line must be drawn, or finding a series of tangents to the section. In giving an example of the projection of a body bounded by a curved surface, we shall select a case of frequent occurrence in practice, referring to the *Géométrie Descriptive* of Monge, for more general methods.

Let ABC be part of the plan of the base of a solid, fig. 3, and FED its end elevation; the upper side of the solid being bounded by the curved surface FD. This solid is supposed to be cut at AB by a plane perpendicular to the base, and our intention is to show the form of the section.

Draw EH parallel to BA, and GHE will represent the plane upon which the section is to be projected. Set off any convenient number of points, 1, 2, 3, 4, &c. in the given curve FD, from each of these points draw a line perpendicular to ED, to meet BA; and from the points in BA, thus determined, erect perpendiculars, which will cut HE at right angles. Make GH equal to FE, and set off the points 1, 2, 3, &c. in GHE at the same distances respectively from HE, as the corresponding points 1, 2, 3, &c. in EFD are from the line ED. A curve

Joinery.

being drawn through the points E, 1, 2, 3, 4, 5, G will complete the section. In large works the joiner will often find it useful to put nails in the points, and to bend a regular lath against the nails; with the assistance of the lath the curve may be drawn with more regularity.*

If the curve FD were very irregular, or a mixed line of straight parts and curved ones, the same method would determine the section; all the caution required is, that a sufficient number of points should be fixed upon in the given curve; and upon the proper selection of these points much of the accuracy of the section will depend.

The angle ribs of groined ceilings, the angle ribs for coved ceilings, or brackets for large cornices, and the angle cantilevers for balconies or other works of a similar kind, are found by this method. If FD be the cross rib of a groin, then GE will be the form of the corresponding angle rib. Also, if the angle of a room be represented by LAC, and FD be the cove for the ceiling, then GE will be the proper angle rib for such a cove.

In some cases, the section may be determined by means of the properties of the given curve, when the nature of that curve is known. Thus the oblique section of a cylinder is an ellipse, and the sections of a cone are certain figures depending on the direction of the plane of section (see CONIC SECTIONS, in the *Encyclopædia*); but if an architect were confined to the use of geometrical curves, there would be small scope, indeed, for a display of taste in his art, therefore the joiner must generally have recourse to the simple method we have described.

10. The section of a body may often be drawn by a more simple and direct process; and yet where the principle is still the same. Thus, the section of the half cylinder ACB, in fig. 4, being compared with the process in fig. 3, will be found to be the same in every respect, excepting in the position of the parts of the figure. In fig 4, ACB is the end or plan of the cylinder, and DE the inclination of the plane by which it is cut. Let the ordinates a 1, b 2, &c. in the plan, be drawn perpendicular to AB, and continued till they cut the inclined line DE. Also, draw the ordinates a' 1', b' 2', &c. perpendicular to the line DE, and make the distances a' 1', b' 2', &c. respectively equal to the corresponding distances a 1, b 2, &c. upon the plan. Through the points E, 1', 2', &c. draw the curve DFE.

As the curve DFE is an ellipse, when ABC is a circle, in that case it will be better to draw an ellipse with a trammel, or any other machine that produces the curve by a continued motion. (See ELLIPTOGRAPH in this *Supplement.*) DE is the transverse, and Fc' the semi-conjugate axis of the ellipse.

The most important application of the case, in fig. 4, is to the hand-railing of a staircase, with a curvilineal well-hole, or opening down the middle. For, if Ae, or aB, show the breadth of the rail, Ac C a B would be its plan; and De' F a' E the form of a mould, commonly called a face mould, for cutting out the rail by, when DE is the inclination of the plank. We cannot, however, proceed directly to the subject of stair-rails, without considering the developement of the surfaces of bodies.

Developement of Surfaces.

11. To develope the surface of a solid is to draw, on some plane surface, a form that would cover it. If this form were drawn upon paper, and the paper were cut to it, the paper, so cut, ought to cover exactly the surface of the solid. Now, in joinery, it is often required that a mould should apply to a curved surface; and, therefore, the developement of that surface upon a flexible material gives the form of the mould. To develope a Pyramid.

The covering of a square pyramid may be found by erecting a perpendicular from the middle of one of the sides of its base, as from a in the side AB, fig. 5. Upon this perpendicular set off a C equal to the slant height of the pyramid; then, with the radius AC and centre C describe the arc A3, and set off the distance AB three times upon the arc. Join the points C3, C2, C1, CA, and CB, and draw the lines 32, 21, 1A, which determine the covering required.

It is obvious that we could develope a pyramid of which the base might have any number of sides, by the same method; and that a near approximation to the developement of a right cone might be effected by the same means, which, in fact, is the means usually employed. But the following method of spreading out the surface of a cone will be found more correct.

12. Let ABC, fig. 6, be an elevation of a cone, and ADB half the plan of its base. With the radius AC describe the arc AE, which will be the line bounding the developement; and, to find the length of the arc, or rather the angle containing it, multiply 360 by the radius Aa of the base, and divide the product by the slant height AC of the cone; the quotient will be the number of degrees in the arc AE, when the surface ACE exactly covers the whole cone. Thus, let Aa be 12 feet, and AC 40 feet; then $\frac{360\times 12}{40}=108$ degrees, and making ACE an angle of 108 degrees, we have the sector ACE that would cover the cone. To develope a Cone.

This applies to the soffits of windows, where they are enlarged towards the inside, to admit light more freely than square recesses would do. If ab be the width of the soffit, draw cb parallel to AB, and from the centre C describe the arc cd. Then half the developement AEcd will be the mould for the soffit; or the form of a veneer that would cover it.

13. The developement of a cylinder is also of use in forming the moulds for soffits, but is still more useful in the construction of stairs; and, as we are To develope a Cylinder.

* A simple and convenient instrument for this purpose is described in the *Transactions of the Society of Arts*, for 1817, Vol. XXXV. p. 109.

obliged to consider it as a prism with numerous sides, it is obvious that any other body of a like kind may be developed by the same means.

Let ACB, fig. 7, be the plan of half a cylinder, and A'E its height. Divide the curve ACB into any convenient number of equal parts, and let these parts be set off from C to A, and from C to B'. When the curve is a semicircle, divide the diameter AB into the proposed number of parts, and make *a*D equal to 3-4ths of the radius. From D through the points A and B, draw the lines DA', DB', then A'B' is nearly equal to the curve ACB stretched out;* and, by drawing a line from D through each of the divisions in AB, the line A'B' will be divided into the same number of equal parts.

In either case, erect a perpendicular from each point of division, and EA'B'F will be the developement of the surface.

If we suppose A'B' to be divided into the number of steps, that would be necessary to ascend from B to A, in a circular staircase, the developement of the ends of these steps may be drawn as in the upper part of the figure. The projection G of the cylinder, with the lines of the developement drawn upon it, and the ends of the steps, shows the waving line formed by the nosings of the steps, and consequently by the hand-rail of a circular staircase.

When a part of a cylinder is cut off by a plane, the line of section will be a curved line upon the developement, as is shown in the lower part of the developement, fig. 7. The faint lines show the manner of finding the edge of the covering, and is the same as finding a mould for a soffit formed by an arch cutting obliquely into a straight wall.

To develope an Oblique Cone.

14. In an oblique cone, the lines drawn on its surface, from its base to the vertex, would be of different lengths, and as those lengths are not shown by the plan, or elevation, they may be had by means of the principle stated in art. 6.

Let ABC, fig. 8, be the given cone, and AEB a plan of half its base; to find the developement, produce AB, and from the vertex, C, let fall the perpendicular CD. Divide the circumference of the base into any number of equal parts, and from each point of division describe an arc from D, as a centre, to cut the line AB at 1, 2, 3, &c. From C, as a centre, describe the arcs AA', 11, 22, &c. and with a radius equal to one of the divisions of the circumference of the base, and the centre B cross the arc 55, which determines the point 5 in the developement, with the same radius, and the point 5, as a centre cross the arc 44, and so on for the remainder of the arcs. Join A'C, and draw a curve line through the points A', 1, 2, &c. which gives the covering for half an oblique cone.

If the cone be cut by a plane, *ab*, parallel to the base, the surface *Bba*A' will be the covering of a soffit for a conical arch cutting obliquely into a straight wall.

To find the Covering of a Soffit.

15. As it often happens that there is not a sufficient space between the head of a door, or a window, and the cornice of the ceiling to admit of the same bevel being preserved at the crown or top, as at the sides of the window, in such cases the soffit is made level at the crown, or with such an inclination only as will prevent the architrave cutting into the cornice of the room.

Let ABCD be the plan of the space to be covered with a soffit, fig. 9, ED the arch of half the opening, which is in its proper position when set perpendicularly over the line CD; and let F*c* be the height of the arch over AB. Produce AC and BD to meet at G; set off *cm* equal to *c*F, and 3*n* equal to 3E; then draw a line through the points *mn*, which will give the inclination of the soffit at the highest part of it. Divide the arch ED into any number of equal parts (in our example we have only divided it into three parts), and from each point of division let fall a perpendicular to CD, meeting the line CD in the points 1, 2. Through these points draw the lines G*a*, G*b*, cutting the line AB in the points *ab*, and from each point erect a perpendicular to AB. Set off, on 3*n*, the heights of the points in the curve ED, and divide the line *mc* in the same proportion as *n*3, which will give the corresponding heights for the arch FD, and through the points thus found the arch FD should be drawn.

Make G*o* perpendicular to GE cutting a line passing through the points *m*, *n*, in *o*, and draw lines through the corresponding points of division in the lines *mc*, *n*3, so that G*o* may be divided in the same proportion as *n*3. Draw G*p* perpendicular to GD, and equal to G*o*, and set off upon it the same distances as are upon G*o*. Then, with a radius G1, and the first division on G*p*, as a centre, describe an arc at *s*, and with a radius equal to one of the divisions of the arc ED and D as a centre, cross the arc *s*, which gives one point. Also, with a radius G2, and the second division on G*p*, as a centre, make an arc at *t*, which, being crossed by an arc described with a radius, equal to one of the divisions of the arc ED, and *s* as a centre, determines another point in the edge of the covering. Proceed in the same manner till half the developement of one edge be completed; the other edge will be obtained by drawing lines through the points *s*, *t*, *u*, from the corresponding points in G*p*, and making *sw* equal to *a*1; *tx* equal to *b*2, &c.

As both sides are the same, the soffit mould for one side requires only to be reversed for the other side. If the soffit be level at the crown, the process may be rendered shorter; but, where it is possible to get space for a slight inclination, the appearance of the soffit is always materially improved.

If the plan of the wall be circular, find the developement of the arc ED as before, and transfer the distances from CD of the points in the curved wall, to the corresponding lines in the developement, in the same manner as was done to find the edge B*wxy*.

To develope a Sphere.

16. The developement of a sphere, or globe, can be effected only by an approximate process, as it is impossible to apply a plane surface so as to touch more than one point at a time; but various methods

* This has been shown by Dr C. Hutton, in his *Mathematical Tracts*, Vol. I. p. 160.

Joinery. may be employed, which are useful in forming spherical surfaces.

A sphere may be divided into numerous zones, the surface of each zone may be considered as that of the frustum of a cone, and developed in the same manner as has been described for a portion of a cone in art. 12. The upper part of fig. 10 shows half a sphere developed in this manner; and when it is divided into very narrow zones, the covering found by this process has some advantages, in practice, that are peculiar to it.

17. The surface of a sphere may also be developed by inscribing it in a cylinder, LNMO, fig. 10, and considering a small portion, or gore, ABD, to coincide with the surface of the cylinder. Then, if the portion ABD, considered as part of a cylinder, be developed by the process described in art. 13, one gore, AB*d*, will be obtained, and by dividing the circumference of the sphere into any number of equal parts, and making AB equal to one of these parts, the same mould will serve for the whole of the sphere.

Another method of developing a sphere consists in supposing it to be a polyhedral, or many-sided figure, but this method has no advantage over the preceding ones, while it has the inaccuracies of both of them.

In lining and boarding domes, the position of the ribs to which the boards are to be fixed will determine the method of developement that ought to be adopted; but the form of the veneers for a spherical surface may be determined by either method.

To determine the Angle formed by two Inclined Planes.

To find the Angle of Planes inclined to one another.

18. The angle made by two planes which cut one another, is the angle contained by two straight lines drawn from any, the same, point in the line of their common section, at right angles to that line; the one in the one plane, and the other in the other.* This angle is the same as that which the joiner takes with his bevel, the bevel being always applied so that its legs are square from the arris, or common section of the planes.

If two lines, AB and CD, be drawn upon a piece of pasteboard, at right angles to one another, crossing at the point E, and the pasteboard be cut half through, according to the line AB, so that it may turn upon that line as a joint; then, to whatever angle, CED, fig. 11, the parts may be turned, the lines EC, and ED, will be always in the same plane. Also, a line FD, drawn from any point D, in the line ED, to any point, F, in the line EC, will be always in the same plane. From these self-evident properties of planes, it is easy to determine the angle formed by any two planes, when two projections, or one projection and the developement of the surfaces, are given.

19. Let ABC, fig. 12, be the plan of part of a pyramid, and BD the elevation of the arris, or line formed by the common section of the planes in respect to the line EB; EB being the projection of that arris upon the plan. Joinery.

Draw AC perpendicular to EB, cutting it in any point E, and from E draw EF perpendicular to DB. With the radius EF, and centre E, cross EB in *f*; and join A*f* and *f*C, then the angle A*f*C is the angle formed by the planes of the pyramid.

The angle may be constructed when the plan and elevation of any two lines drawn in the planes, so as to intersect in the arris, are given, but as these projections are not often given in drawings of joiners' work, we have inserted the preceding, though it be a less general method.†

The backing, or angle for the back of hip-rafters in carpentry, and of hipped sky-lights, is found in this manner; ABC being, in that case, supposed to be the plan of an angle of the roof or sky-light, and DB the inclination of the hip-rafter.

20. To show how the angle formed by two planes may be found when the plan and developement are given, let it be required to find the angle contained by the two faces of a square pyramid, fig. 5.

Draw FB perpendicular to AC, and with the radius BF, and centre B, describe the arc FG. Then, with the radius DB, and centre F, cross the former arc in G, join BG, and FBG is the angle formed by two, the inclined faces of the pyramid.

Raking Mouldings.

21. When an inclined, or raking moulding, is intended to join with a level moulding, at either an exterior or an interior angle, the form of the level moulding being given, it is necessary that the form of the inclined moulding should be determined, so that the corresponding parts of the surfaces of the two mouldings should meet in the same plane; this plane being the plane of the mitre. It may be otherwise expressed, by saying, that the mouldings should mitre truly together. Raking Mouldings.

If the angle be a right angle, the method of finding the form of the inclined moulding is very easy; and as it is not very difficult for any other angle, it may perhaps be best to give a general method, and, to illustrate it by examples of common occurrence.

General Method of Describing a Raking Moulding, when the Angle and the Rake, or Inclination of the Moulding, is given.

Let ABC, fig. 13, be the plan of the angle of a body, which is to have a level moulding on the side AB; and this level moulding is to mitre with an inclined moulding on the side BC. Also, let CBD be the angle the inclined moulding makes with a level or horizontal line BC. General Method.

Produce AB, and draw C*b* perpendicular to AB; also make DC perpendicular to BC, and *d*C perpen-

* This is the definition given by Professor Playfair, in his *Elements of Geometry*, and is better suited to our purpose than Euclid's definition.

† On this subject, the reader may consult Monge's *Géométrie Descriptive*, Art. 19 et 20, par. 23 and 24, 4th edition, Paris, 1820.

Joinery.

dicular to bC. Set off Cd equal to CD, and join bd; then the inclined moulding must be drawn on lines parallel to bd.

Let 1, 2, 3, 4, &c. be any number of points in the given section of the level moulding; from each of these points draw a line parallel to bd; and draw Ab' perpendicular to bd. Set off the points 1′, 2′, 3′, 4′, &c. at the same distances, respectively, from the line Ab', as the corresponding points 1, 2, 3, 4, &c. are from the line AB; and through the points 1′, 2′, 3′, &c. draw the moulding. The moulding thus found will mitre with the given one, also supposing the inclined moulding to be given, the level one may be found in like manner.

If the angle ABC be less than a right angle, the whole process remains the same; but when it is a right angle, BD coincides with bd; and the method of describing the moulding becomes the same as that usually given; as it does not then require the preparatory steps which are necessary when the angle is any other than a right angle.

For Pediments.

22. It is in pediments, chiefly, that the method of forming raking mouldings is of use. Fig. 14 represents part of a pediment; AB is that part of the level moulding which mitres with the inclined moulding; all that part of the cornice below B, being continued along the front, the lower members of the raking cornice stop upon it, and, therefore, do not require to be traced from the other.

In that part of the cornice marked AB, set off a sufficient number of points; and from each of these points draw a line parallel to the rake, or inclination of the pediment. Also, let a vertical line be drawn to each of the same points from the horizontal line rs. Make $s't$ perpendicular to the inclination of the pediment, and with a slip of paper, or by means of arcs of circles, transfer the distances on rs to the line $r's$, and from the points thus found, draw lines parallel to st; the intersection of these, with the inclined lines, will determine the form of the moulding, as is indicated by the letters.

When a pediment has a cornice with modillions, the caps of the modillions require to be traced by the same method.

For Skirtings.

23. It sometimes happens, that an inclined base-moulding has to mitre with a level one at an angle; and as the same thing occurs still more frequently with other mouldings, such as cornices under the steps of stairs, &c. we shall give another example, which will serve still farther to illustrate the method of proceeding in such cases.

In fig. 15, a raking base-moulding is shown, where the inclined moulding B is traced to mitre with the horizontal moulding C; and the horizontal moulding A is traced to mitre with the inclined one B. The preceding examples being understood, the lines and letters in the figure will be sufficient to show how the mouldings are traced.

Remarks on Mouldings.

24. Mouldings being almost the only part of modern joiners' work, which can, in strictness, be called ornamental, and consequently that in which the taste of the workman is most apparent, we shall offer a remark or two that may have their use. The form of a moulding should be distinct and varied, forming a bold outline of a succession of curved and flat surfaces, disposed so as to form distinct masses of light and shade. If the mouldings be of considerable length, a greater distinction of parts is necessary than in short ones.

Mouldings for the internal part of a building should not, however, have much projection; the proper degree of shade may always be given, with better effect, by deep sinkings judiciously disposed. The light in a room is not sufficiently strong, to relieve mouldings, without resorting to this method; and hence it is that quirked mouldings are so much esteemed.

Sect. II.—On the Construction of Joiners' Work.

Qualifications of a Good Joiner.

25. The goodness of joiners' work depends chiefly upon the care that has been bestowed in joining the materials. In carpentry, framing owes its strength to the form and position of its parts; but in joinery, the strength of a frame depends upon the strength of the joinings. The importance, therefore, of fitting the joints together as accurately as possible, is obvious. It is very desirable, that a joiner should be a quick workman; but it is still more so that he should be a good one; that he should join his materials with firmness and accuracy; that he should make surfaces even and smooth, mouldings true and regular, and the parts intended to move, so that they may be used with ease and freedom.

Where despatch is considered as the chief excellence of a workman, it is not probable that he will strive to improve himself in his art, further than to produce the greatest quantity of barely tolerable work with the least quantity of labour. In some articles of short duration, despatch in the manufacture may be of greater importance; but in works that ought to remain firm for years, it certainly is bad economy to spare a few shillings' worth of labour at the risk of being annoyed with a piece of bad work as long as it will hold together.

We have seen, with no small degree of pleasure, the effect of encouraging good workmanship in the construction of machinery, and would recommend that a like encouragement should be given to superior workmen in other arts.

Joining Angles.

Of Joining Angles.

26. When the length of a joint at an angle is not considerable, it is sufficient to cut the joint, so that when the parts are joined, the plane of the joint shall bisect the angle. This kind of joint is shown for two different angles, by fig. 16, Plate LXXXVII.

When an angle of considerable length is to be joined, and the kind of work does not require a joining should be concealed, fig 17 is often employed; the small bead renders the appearance of the joint less objectionable, because any irregularities, from shrinkage, are not seen in the shade of the quirk of the bead.

A bead upon an angle, where the nature of the thing does not determine it to be an arris, is attended with many advantages; it is less liable to be injured, and admits of a secure joint, without the ap-

Joinery. pearance of one. Fig. 18 shows a joint of this description, which should always be used in passages.

Fig. 19 represents a very good joint for an exterior angle, whether it be a long or a short one. Such a joint may be nailed both ways. But the joint represented by fig 20 is superior to it; the parts being drawn together by the form of the joint itself, they can be fitted with more accuracy, and joined with certainty. The angles of pilasters are often joined, as fig. 20.

Interior angles are commonly joined, as shown by fig. 21. If the upper or lower edge be visible, the joint is mitred, as in fig. 16, at the edge only, the other part of the joint being grooved, as in fig. 21. In this manner are put together the skirting and dado at the interior angles of rooms, the backs, and back-linings of windows, the jambs of door-ways, and various other parts of joiners' work.

Framing.

The object of Framing. 27. Frames in joinery are usually connected by mortise and tenon joints, with grooves to receive pannels. Doors, window-shutters, &c. are framed in this manner. The object in framing is, to reduce the wood into narrow pieces, so that the work may not be sensibly affected by its shrinkage; and, at the same time, it enables us to vary the surface without much labour.

From this view of the subject, the joiner will readily perceive, that neither the parts of the frame nor the pannels should be wide. And, as the frame should be composed of narrow pieces, it follows, that the pannels should not be very long, otherwise the frame will want strength. The pannels of framing should not be more than about 15 inches wide, and 4 feet long, and pannels so large as this should be avoided as much as possible.* The width of the framing is commonly about one-third of the width of the pannel.

It is of the utmost importance, in framing, that the tenons and mortises should be truly made. After a mortise has been made with the mortise chisel, it should be rendered perfectly even with a float; an instrument which differs from a single cut, or float file, only by having larger teeth. An inexperienced workman often makes his work fit too tight in one place, and too easy in another, hence the mortise is split with driving the parts together, and the work is never firm; whereas if the tenon fill the mortise equally, without using any considerable force in driving the work together, it is found to be firm and sound. The thickness of tenons should be about one-fourth of that of the framing, and the width of a tenon should never exceed about five times its thickness, otherwise, in wedging, the tenon will become bent, and bulge out of the sides of the mortise. If the rail be wide, two mortises should be made, with a space of solid wood between; fig. 22 shows the tenons for a wide rail.

In thick framing, the strength and firmness of the joint is much increased by putting a cross or feather tongue in on each side of the tenon; these tongues are about an inch in length, and are easily put in with a plough proper for such purposes. The projected figure of the end of a rail, fig. 22, shows these tongues put in, in the style there are grooves ploughed to receive them.

Sometimes, in thick framing, a double tenon in the thickness is made; but we give the preference to a single one, when tongues are put in the shoulders, as we have described; because a strong tenon is better than two weak ones, and there is less difficulty in fitting one than two.

The pannels of framing should be made to fill the grooves, so as not to rattle, and yet to allow the pannels to shrink without splitting.

28. When a frame consists of curved pieces, they are often joined by means of pieces of hard wood called keys. Fig. 23 is the head of a Gothic window frame, joined with a key, with a plan of the joint below it. A cross tongue is put in on each side of the key, and the joint is tightened by means of the wedges *aa*. Joining curved pieces.

It is, however, a better method to join such pieces by means of a screw bolt instead of a key, the cross tongues being used whichever method is adopted.

Joining with Glue.

29. It is seldom possible to procure boards sufficiently wide for pannels without a joint, on account of heart shakes, which open in drying. In cutting out pannels, for good work, shaken wood should be carefully avoided. That part near the pith is generally the most defective. Joining with Glue.

If the pannels be thick enough to admit of a cross or feather tongue in the joint, one should always be inserted, for then, if the joint should fail, the surfaces will be kept even, and it will prevent light passing through.

Sometimes plane surfaces of considerable width and length are introduced in joiners' work, as in dado, window backs, &c.; such surfaces are commonly formed of inch, or inch and quarter, boards joined with glue, and a cross or feather tongue ploughed into each joint. When the boards are glued together, and have become dry, tapering pieces of wood, called keys, are grooved in, across the back, with a dovetail groove. These keys preserve the surface straight, and also allow it to shrink and expand with the changes of the weather.

30. It would be an endless task to describe all the methods that have been employed to glue up bodies of such varied forms as occur in joinery; for every joiner forms methods of his own, and merely from his being most familiar with his own process, he will perform his work, according to it, in a better manner than by another, which, to an unprejudiced mind, has manifestly the advantage over it. The end and aim of the joiner, in all these operations, is to avoid the peculiar imperfections and dis- Glueing up curved work.

* Pannels of external doors and shutters may be rendered more secure by boring them, and inserting iron wires. See *Trans. Society of Arts*, Vol. XXV. p. 106.

Joinery. advantages of his materials, and to do this with the least expence of labour or material. The straightness of the fibres of wood renders it unfit for curved surfaces, at least when the curvature is considerable. Hence short pieces are glued together as nearly in the form desired as can be, and the apparent surface is covered with a thin veneer; or the work is glued up in pieces that are thin enough to bend to the required form. Sometimes a thin piece of wood is bent to the required form upon a cylinder or saddle, and blocks are jointed and glued upon the back; when the whole is completely dry it will preserve the form that had been given to it by the cylinder.

To determine the thickness of the pieces to be glued together. The proper thickness for the pieces to be bent may be easily determined by an easy experiment on a piece of the same kind of wood. Thus, select a piece of wood, of the same kind as that to be used, and bend it as much as it will bear without injury; then ascertain the radius of curvature, and also the thickness of the piece, at the most curved part of it. From these data the proper thickness for any other curve will be determined by the following proportion:

As the radius of curvature, found by experiment, is to the thickness of the piece tried; so is the radius of any other curve to the thickness of the piece that may be bent into it.*

For example, we have found that a piece of straight grained white deal, of an inch in thickness, may be bent, without injury, into a curve of which the radius is 120 inches, therefore, 120 : 1 : : radius : thickness $\frac{\text{radius}}{120}$ That is, a piece of deal of the same quality may be bent into any curve, of which the radius is not less than 120 times its thickness.

A piece of work glued up in thicknesses should be very well done; but it too often happens that the joints are visible, irregular, and in some places open; therefore other methods have been tried.

Bending by Steaming or Boiling. 31. If a piece of wood be boiled in water for a certain time, then taken out and immediately bent into any particular form, and it be retained in that form till it be dry, a permanent change takes place in the mechanical relations of its parts; so that, though when relieved, it will spring back a little, yet it will not return to its natural form.

The same effect may be produced by steaming wood; but though both these methods have been long practised to a considerable extent in the art of ship-building, we are not aware that any general principles have been discovered, either by experiment or otherwise, that will enable us to apply it to an art like joinery, where so much precision is required. We are aware that it has been tried; but, before it can be rendered extensively useful, the relation between the curvature to which it is bent, and that which it assumes, when relieved, should be determined, and also the degree of curvature which may be given to a piece of a given thickness.

The time that a piece of wood should be boiled, or steamed, in order that it may be in the best state for bending, should be made the subject of experiments; and this being determined, the relation between the time and the bulk of the piece should be ascertained. Joinery.

For the joiner's purposes, we imagine, that the process might be greatly improved, by saturating the convex side of each piece with a strong solution of glue, immediately after bending it. By filling, in this manner, the extended pores, and allowing the glue to harden thoroughly before relieving the pieces, they would retain their shape better.

32. Large pieces of timber should never be used in joinery, because they cannot be procured sufficiently dry to prevent them splitting with the heat of a warm room. Therefore, the external part of columns, pilasters, and works of a like kind, should be formed of thin pieces of dry wood; and, if support be required, a post, or an iron pillar, may be placed within the exterior column. Thus, to form columns of wood, so that they shall not be liable to split, narrow pieces of wood are used, not exceeding five inches in width. These are jointed like the staves of a cask, and glued together, with short blocks glued along at each joint. Glueing up Wooden Columns.

Fig. 24 is a plan of the lower end of a column glued up in staves; the bevel at A is used for forming the staves, that at B is used for adjusting them when they are glued together. A similar plan must be made for the upper end of the column, which will give the width of the upper end of the staves. The bevels taken from the plan, as at A and B, are not the true bevels; but they are those generally used, and are very nearly true, when the columns are not much diminished. To find the true bevels, the principle we have given in art. 19 should be applied. The same method may be adopted for forming large pillars for tables, &c.

If a column have flutes, with fillets, the joints should be in the fillets, in order to make the column as strong as possible; also, if a column be intended to have a swell in the middle, proper thickness of wood should be allowed for it.

When columns or pillars are small, they may be made of dry wood; and to secure them against splitting, a hole may be bored down the axis of each column. Small columns, Table Legs, &c.

Fixing Joiners' Work.

33. We have hitherto confined our remarks to that part of joinery which is performed at the bench; but by far the most important part remains to be considered. For, however well a piece of work may have been prepared, if it be not properly fixed, it cannot fulfil its intended purpose. As in the preceding part, we shall state the general principles that ought to be made the basis of practice, and illustrate those principles by particular examples. Fixing Work together.

If the part to be fixed consist of boards jointed together, but not framed, it should be fixed so that it may shrink, or swell without splitting. The na-

* The reader will find some interesting propositions relating to flexure in the Article CARPENTRY, p. 624, Vol. II.

ture of the work will generally determine how this may be effected. Let us suppose that a plain back of a window is to be fixed. Fig. 25 is a section showing B the back of the window, A the window sill, D the floor, and C the skirting. The back B is supposed to be prepared, as we have stated in art. 29, and that it is kept straight by a dovetailed key *a*. Now, let the back be firmly nailed to the window sill A, and let a narrow piece *d*, with a groove, and cross tongue, in its upper edge, be fixed to bond timbers or plugs in the wall; the tongue being inserted also into a corresponding groove in the lower edge of the back B. It is obvious, that the tongue being loose, the back B may contract or expand, as a pannel in a frame. The dado of a room should be fixed in the same manner. In the principal rooms of a house, the skirting C is usually grooved into the floor D, and fixed only to the narrow piece *d*, which is called a ground. By fixing, in this manner, the skirting covers the joint, which would otherwise soon be open by the shrinking of the back; and from the skirting being grooved into the floor, but not fastened to it, there cannot be an open joint between the skirting and floor. When it is considered, that an open joint, in such a situation, must become a receptacle for dust, and a harbour for insects, the importance of adopting this method of fixing skirting will be apparent.

Fixing Skirting for Rooms.

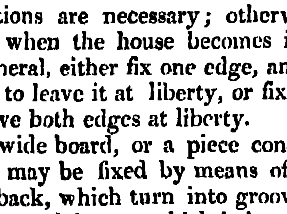
In fixing any board above five or six inches wide, similar precautions are necessary; otherwise, it is certain to split when the house becomes inhabited. We may, in general, either fix one edge, and groove the other, so as to leave it at liberty, or fix it in the middle, and leave both edges at liberty.

Fixing Landings of Stairs, Tops of Tables, &c.

Sometimes a wide board, or a piece consisting of several boards, may be fixed by means of buttons, screwed to the back, which turn into grooves in the framing, bearers, or joists, to which it is to be fixed. If any shrinking takes place the buttons slide in the grooves. In this manner the landings of stairs are fixed, and it is much the best mode of fixing the top of a table to its frame.

Forming Architraves, &c.

34. The extension of the principle of ploughing and tongueing work together is one of the most important of the improvements that have been introduced by modern joiners. It is an easy, simple, and effectual method of combination, and one that provides against the greatest defect of timber work, its shrinkage. By means of this method, the bold mouldings of Gothic architecture can be executed with a comparatively small quantity of material; and even in the mouldings of modern architecture it saves much labour. For example, the moulded part of an architrave may be joined with the plain part, as shown by this figure. If this method be compared with the old method of glueing one piece upon another,



its advantage will be more evident.

Fixing Grounds

35. The architraves, skirtings, and surbase mouldings, are fixed to pieces of wood called *grounds*; and as the straightness and accuracy of these mouldings must depend upon the care that has been taken to fix the grounds truly; it will appear, that fixing grounds, which is a part often left to inferior workmen, in reality requires much skill and attention; besides, they are almost always the guide for the plasterer. Where the plasterer's work joins the grounds, they should have a small groove ploughed in the edge to form a key for the plaster.

Laying Floors.

36. In our remarks on construction, we must not omit to say a few words on laying floors, because it will give us an opportunity of pointing out a defect which might be easily remedied. The advice of Evenly, to tack the boards down only the first year, and nail them down for good the next, is certainly the best, when it is convenient to adopt it; but, as this is very seldom the case, we must expect the joints to open more or less. Now these joints always admit a considerable current of cold air, and also, in an upper room, unless there be a counter floor, the ceiling below may be spoiled by spilling a little water, or even by washing the floor. To avoid this, we would recommend a tongue to be ploughed into each joint, according to the old practice. When the boards are narrow, they might be laid without any appearance of nails, in the same way as a dowelled floor is laid, the tongue serving the same purpose as the dowels. In this case, we would use cross or feather tongues for the joints.

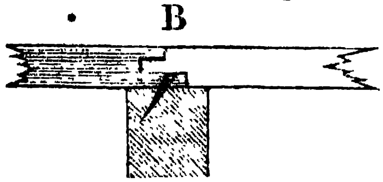
Folding Floors censured

There is a method sometimes used in laying floors, which workmen call folding; according to this method, two boards are laid, and nailed at such a distance apart that the space is a little less than the aggregate width of the boards intended for it; these boards are then put to their places, and, on account of the narrowness of the space left for them, they rise like an arch between its abutments. The workmen force them down by jumping upon them. Accordingly, the boards are never soundly fixed to the joists, nor can the floor be laid with any kind of evenness or accuracy. We merely notice this method here, in order that it may be avoided.

Heading Joints.

As boards can seldom be got long enough to do without joints, it is usual, except in very inferior work, to join the ends with a tongued joint, as shown by the figure, where B is the joist. The etched board is first laid, and nailed to the joist.

B



In oak floors, the ends are forked together sometimes as shown at A, in order to render the joints less conspicuous. The joints should be kept as distant from one another as possible.

A

Hinging.

Hinging.

37. It requires a considerable degree of care to hang a door, a shutter, or any other piece of work in the best manner. In the hinge, the pin should be

perfectly straight, and truly cylindrical, and the parts accurately fitted together.

The hinges should be placed so that their axes may be in the same straight line, as any defect in this respect will produce a considerable strain upon the hinges every time the hanging part is moved, which prevents it from moving freely, and is injurious to the hinges.

In hanging doors, centres are often used instead of hinges; but, on account of the small quantity of friction in centres, a door moves too easily, or so that a slight draft of air accelerates it so much in falling to, that it shakes the building, and is disagreeable. We have seen this in some degree remedied by placing a small spring to receive the shock of the door.

The greatest difficulty, in hanging doors, is to make them to clear a carpet, and be close at the bottom when shut. To do this, that part of the floor which is under the door, when shut, may be made to rise above a quarter of an inch above the general level of the floor; which, with placing the hinges so as to cause the door to rise as it opens, will be sufficient, unless the carpet should be a very thick one. Several mechanical contrivances have been used for either raising the door, or adding a part to spring close to the floor as the door shuts. The latter is much the better method. The reader who may be desirous of examining this method, may consult the *Transactions of the Society of Arts*, &c. Vol. XXVI. p. 196.

38. Various kinds of hinges are in use. Sometimes they are concealed, as in the kind of joints called rule joints; others project, and are intended to let a door fold back over projecting mouldings, as in pulpit doors. When hinges project, the weight of the door acts with an increased leverage upon them, and they soon get out of order, unless they be strong and well fixed.

Room Doors.

The door of a room should be hung so that, in opening the door, the interior of the room cannot be seen through the joint. This may be done by making the joint according to fig. 26. The bead should be continued round the door, and a common but-hinge answers for it.

The proper bevel for Joints of a Door.

The proper bevel for the edge of a door or sash may be found by drawing a line from the centre of motion C, fig. 27, to *c*, the interior angle of the rebate, draw *cd* perpendicular to C*c*, which gives the bevel required. In practice, the bevel is usually made less, leaving an open space in the joint when the door is shut; this is done on account of the interior angle of the rebate often being filled with paint.

Stairs.

Stairs.

39. The construction of stairs is generally considered the highest department of the art of joinery, therefore we treat of it under a distinct head.

The principal object to be attended to in stairs is, that they afford a safe and easy communication between floors of different levels. The strength of a stair ought to be apparent as well as real, in order that those who ascend it may feel conscious of safety. In order to make the communication safe, it should be guarded by a railing of proper height and strength; in order that it may be easy, the rise and width, or tread, of the steps should be regular and justly proportioned to each other, with convenient landings; there should be no winding steps, and the top of the rail should be of a convenient height for the hand.

Proper proportion for Steps.

The first person that attempted to fix the relation between the height and width of a step, upon correct principles, was, we believe, Blondel, in his *Cours d'Architecture.* If a person walking upon a level plane, move over a space, P, at each step, and the height which the same person could ascend vertically, with equal ease, were H; then, if h be the height of a step, and p its width; the relation between p and h must be such, that when $p=\mathrm{P}$, $h=o$; and when $h=\mathrm{H}$, $p=o$. These conditions are satisfied by an equation of the form $h=\mathrm{H}\left(1-\frac{p}{\mathrm{P}}\right)$. Blondel assumes 24 inches for the value of P, and 12 inches for that of H; substituting these values in our equation, it becomes $h=\frac{1}{2}(24-p)$, which is precisely Blondel's rule. We do not think these the true values of P and H; indeed, it would be difficult to ascertain them; but they are so near, and agree so well with our observations on stairs of easy ascent, that they may be taken for the elements of a practical rule. Hence, according as h or p is given, we have $h=\frac{1}{2}(24-p)$, or $p=24-2h$.

Thus, if the height of a step be six inches, then $24-12=12$ the width or tread for a step that rises six inches.

Different kind of Stairs.

40. The forms of staircases are various. In towns, where space cannot be allowed for convenient forms, they are often made triangular, circular, or elliptical, with winding steps, or of a mixed form with straight sides and circular ends. In large mansions, and in other situations, where convenience and beauty are the chief objects of attention, winding steps are never introduced when it is possible to avoid them. Good stairs, therefore, require less geometrical skill than those of an inferior character.

The best architectural effect is produced by rectangular staircases, with ornamented railing and newels. In Gothic structures scarcely any other kind can be adopted, with propriety, for a principal staircase. Modern architecture admits of greater latitude in this respect; the end of the staircase being sometimes circular, and the hand-rail continued, beginning either from a scroll or a newel.

Rectangular Staircase.

41. When a rectangular staircase has a continued rail, it is necessary that it should be curved so as to change gradually from a level to an inclined direction. This curvature is called the *ramp* of the rail. The plan of a staircase of this kind is represented by ABCD, fig. 28, and fig. 29 shows a section of it, supposing it to be cut through at the line *ab*, on the plan.

To find the Cap for Newel.

The hand-rail is supposed to begin with a newel at the bottom, and the form of the cap of the newel ought to be determined, so that it will mitre with

the hand-rail. Let H, fig. 30, be the section of the hand-rail, and *ab* the radius of the cap for the newel; then the form of the cap may be traced at C by the method we have already described. (Art. 9 and 10.)

Height for Rail, &c.

The sections of hand-rails are of various shapes; some of the most common ones are too small; a hand-rail should never be less than would require a square, of which the side is 2½ inches, to circumscribe it.

For the level landings of a staircase the height of the top of the hand-rail should be about 40 inches, and in any part of the inclined rail the height of its upper side above the middle of the width of the step should be 40 inches less the rise of one step, when measured in a vertical direction.

...ribe ...e Ramps ...Rails.

To describe the ramps, let *rs* be a vertical line drawn through the middle of the width of the step, fig. 29; set off *ru* equal to *rs*, and draw *ut* at right angles with the back of the rail, cutting the horizontal line *st* in *t*. From the point *t*, as a centre, describe the curve of the rail. When there is a contrary flexure, as in the case before us, the method of describing the lesser curve is the same.

To draw the Logarithmic Spiral.

12. The hand-rail of a stair often begins from a scroll; and that kind of spiral, which is called the logarithmic spiral, has been proposed as the best for the purpose. It is shown by writers on curve lines, that any radial lines drawn from the centre will be cut by the logarithmic spiral in one and the same angle. By means of this property of the curve, it may be described as follows:

Let C be the centre, fig. 31, and draw AB perpendicular to DE, crossing it in C. Bisect the angles by the lines *ab*, *cd*. Draw *c*B*b* to cut CB at the angle proposed for the curve, and to meet C*b* in *b*; draw *cb* perpendicular to *be*, cutting C*c* in *c*; draw *ca* perpendicular to *cb* cutting C*a* in *a*; and proceed round with as many revolutions as may be required in the same manner. Then B, E, A, D, F, G, &c. are points in the curve, and the lines *eb*, *cb*, *ca*, *ad*, &c. are tangents to the curve at these points. Therefore, the curve may be either drawn by hand, or by means of circular arcs. Also, any number of interior or exterior spirals may be drawn by drawing lines parallel to the tangents, as *xy*, *yz*, &c.

If *cb* were to cross BC at a right-angle, the curve would be a circle.

A new Spiral proposed for Volutes, Scrolls, &c.

43. The scrolls and volutes, used in architecture, are always made to terminate in a circle at the centre; consequently, none of the curves described by mathematicians are adapted for these purposes. But the construction we have employed for the logarithmic spiral readily leads to a species of spiral that appears well suited for scrolls or volutes. In the logarithmic spiral, the angle of the curve is constant; but imagine the angle to change regularly, and to become a right angle at the point, where the circle, called the eye, begins. This would afford us a regular and pleasing curve, unfolding itself from a circle in the centre. This curve might be called the Architectural Spiral.

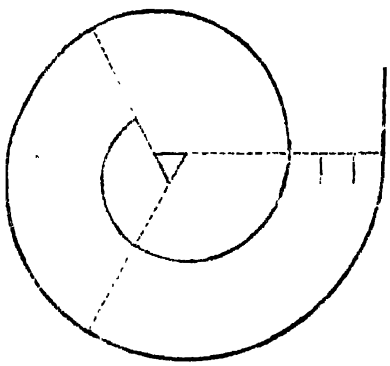
Let C be the centre, fig. 32, and round this centre describe a circle for the eye of the scroll, or volute. Divide this circle into eight equal parts, and draw lines from the centre through the points of division.

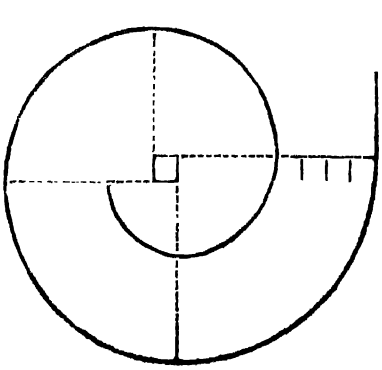
With any radius *a*C, and C as a centre, describe the arc *ac*, and upon this arc set off any number of equal divisions. The extent of a division must be regulated by the quantity the curve may unfold at each revolution, and the number depends on the number of revolutions.

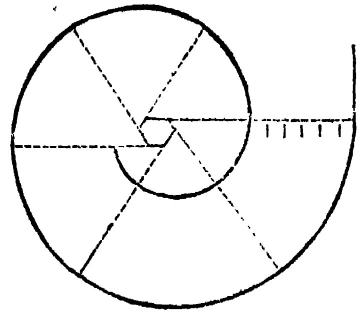
Then, beginning at A, draw A*b* perpendicular to C*a*; *db* parallel to C′; *de* perpendicular to C2; *ef* parallel to C3; and so on for any number of revolutions. The points A, B, D, E, F, G, and H, in the curve, and the tangents to these points, are found, therefore the curve may be described by hand, or by means of circular arcs.

The tangents to any interior or exterior spiral will be parallel to the ones first found, and, therefore, any number may be drawn with the greatest facility.

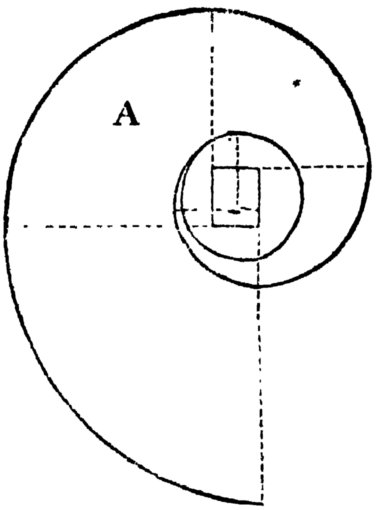
Neither the logarithmic nor the architectural spiral can be drawn truly by circular arcs; but we shall here point out the principle by which such spirals may be drawn. When a spiral is drawn by means of circular arcs only, the centres of the adjoining arcs must always be upon the same straight line; and the regularity of the curve will depend on the number of arcs employed to describe one revolution. Let the proposed distance between the revolutions be divided into as many equal parts as there are to be circular arcs in one revolution; and, on the eye as a centre, construct a regular polygon of the same number of sides as the number of divisions, and each side equal to one division. Then the angles of the polygon will be the centres for describing the spiral, as shown by the figures below, where the triangle, square, and hexagon, are given as examples.

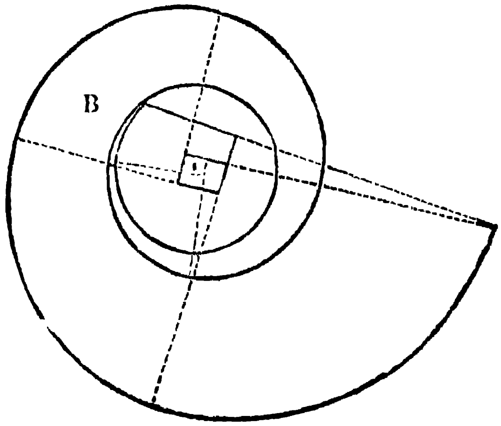






If a spiral be drawn to begin from a circle at the centre, let the arcs be described from the angles of a rectangular fret, as in fig. A, the sides of which may increase in any regular proportion. Or, a figure may be drawn in the same manner as the tangents of the spiral, fig. 32, and the arcs described from the angles, as in fig. B. By either of these methods a pleasing curve may be obtained.





Staircase with Circular ended Well-hole.

44. Fig. 33 represents the plan of a staircase, beginning with a scroll, and having steps winding round the circular part of the well-hole.

In the first place, let the end of the steps be developed according to the method we have given in Art. 13. Fig. 35 shows this developement. Now, the hand-rail ought to follow the inclination of a line drawn to touch the nosings of the steps, except where there is an abrupt transition from the rake of the winding to that of the other steps; at such places it must be curved; the curve may be drawn by the help of intersecting lines, as in fig. 36, if the workman cannot trust to his eye.

Developement of the Circular part.

The part which is shaded in fig. 35 represents the hand-rail and ends of the steps, when spread out, and the hand-rail is only drawn close to the steps for convenience, as it would require too much space to raise it to its proper position. This developement of the rail is called the falling mould.

The wood used for hand-rails being of an expensive kind, it becomes of some importance to consider, how the plank may be cut so as to require the least quantity of material for the curved part of the rail. Now, if we were to suppose the rail executed, and a plain board laid upon the upper side of it, the board would touch the rail at three points; and a plank laid in the same position as the board would be that out of which the rail could be cut with the least waste of material.

To find the Face Moulds.

Let it be required to find the moulds for the part ab of the rail, fig. 33, and to avoid confusing the lines in our small figure, the part ab has been drawn to a larger scale in fig. 34. The plain board, mentioned above, would touch the rail at the points marked C and B in the plan; draw the line CB, and draw a line parallel to CB, so as to touch the curve at the point E. Then E is the other point on the plan; and a', e', and b', are the heights of these points in the developement, fig. 35.

Erect perpendiculars, to CB, from the points C, E, and B, fig. 34, and set off Ca, on fig. 34, equal to $a'c$, fig. 35; Ee equal to de', and Bb equal to fb', Through the points C and E, draw the dotted line Ch; through ae draw a line to meet CE in h; and through the points ab, draw a line to meet CB in g; then join hg, and make Ci perpendicular to hg.

Now, if Cd be made equal to Ca, and perpendicular to Ci; and di be joined, it will be the angle which the plank makes with the horizontal plane, or plan. Therefore, draw FD parallel to Ci, and find the section by the process described in Art. 10. This section is the same thing as would be obtained by projecting vertical lines from each point in the hand-rail against the surface of a board, laid to touch it in three points. The inexperienced workman will be much assisted in applying the moulds if he acquires a clear notion of the position when executed.

To find the Thickness of the Plank.

To find the thickness of the plank, take the height to the under side of the rail cr in the developement, fig. 35, and set it off from s, in the line Ci. to r, in fig. 34; from the point r draw a line parallel to di, and the distance between those parallel lines will be the thickness of the plank.

To apply the Mould.

The mould, fig. 34, which is traced from the plan, is called the *face mould*. It is applied to the upper surface of the plank, which being marked, a bevel should be set to the angle idC, and this bevel being applied to the edge will give the points to which the mould must be placed to mark out the under side. It is then to be sawn out, and wrought true to the mould. In applying the bevel, care should be taken to let its stock be parallel to the line di, if the plank should not be sufficiently wide for di to be its arris.

After the rail is truly wrought to the face mould, the falling mould, fig. 35, being applied to its convex side, will give the edge of the upper surface, and the surface itself will be formed by squaring from the convex side, holding the stock of the square always so that it would be vertical if the rail were in its proper situation. The lower surface is to be parallel to the upper one.

The sudden change of the width of the ends of the steps causes the soffit line to have a broken or irregular appearance; to avoid it the steps are made begin to wind before the curved part begins. Different methods of proportioning the ends of the steps are given by Nicholson, Roubo, Rondelet, and Krafft. We cannot in this place enter into a detail of these methods, but for the reader's information a list of the principal writers on staircases is subjoined.

Price, in his *British Carpenter*, 4to, 1735; Langley, *Builders' Complete Assistant*, 8vo, 1738; Frezier, *Coupe des Pierres et des Bois*, 4to, 1739; Roubo, *L'Art du Menuisier*, folio, 1771; Skaife, *Key to Civil Architecture*, 8vo, 1774; Nicholson, *Carpenters' New Guide*, 4to, 1792; *Carpenters' and Joiners' Assistant*, 4to, 1792; *Architectural Dictionary*, 4to; *Transactions Society of Arts*, &c. for 1814; *Treatise on the Construction of Staircases and Handrails*, 4to, 1820; Rondelet, *Traité de L'Art de Bâtir*, Tome IV. 4to, 1814; and Krafft, *Traité sur L'Art de la Charpenter*, Part II. folio, 1820.

Sect. III.—On Materials.

Importance of the subject.

45. There is no art in which it is required, that the structure and properties of wood should be so thoroughly understood as in joinery. The practical joiner, who has made the nature of timber his study, has always a most decided advantage over those who have neglected this most important part of the art.

In the article Anatomy, Vegetable (*Supplement*), Vol. I. p. 306 and 332, the structure of wood is described; in this place, therefore, we shall only show how the joiner may, in a great measure, avoid the warping caused by its irregular texture.

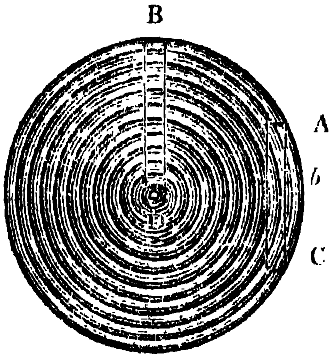
Boards cut in a particular direction will not retain their form.

46. It is well known that wood contracts less in proportion, in diameter, than it does in circumference; hence a whole tree always splits in drying. Mr Knight has shown that, in consequence of this irregular contraction, a board may be cut from a tree, that can scarcely be made, by any means, to retain the same form and position when subjected to various degrees of heat and moisture. From the ash and the beech he cut some thin boards, in different directions relatively to their transverse septa, so that the septa crossed the middle of some of the boards at right angles, and lay nearly parallel with the surfaces of others. Both kinds were placed in a warm room, under perfectly similar circumstances. Those which had been formed by cutting across the transverse septa, as at A in the figure, soon changed their form very considerably, the one side becoming hollow, and the other round; and in drying, they contracted nearly 14 *per cent.* in width.

Difference in shrinkage.

The other kind in which the septa were nearly parallel to the surfaces of the boards, as at B in the marginal figure, retained, with very little variation, their primary form, and did not contract in drying more than three and a half *per cent.* in width.*

As Mr Knight had not tried resinous woods, two specimens were cut from a piece of Memel timber; and, to render the result of our observation more clear, conceive the figure to represent the section of a tree, the annual rings being shown by circles. BD represents the manner in which one of our pieces was cut, and AC the other. The board AC contracted 3·75 *per cent.* in width, and became hollow on the side marked *b*. The board BD retained its original straightness, and contracted only 0·7 *per cent.* The difference in the quantity of contraction is still greater than in hard woods.



From these experiments the advantages to be obtained, merely by a proper attention in cutting out boards for pannels, &c. will be obvious; and it will also be found, that pannels cut so that the septa are nearly parallel to their faces, will appear of a finer and more even grain, and require less labour to make their surfaces even and smooth.

The results of these experiments are not less interesting to cabinet-makers, particularly in the construction of billiard-tables, card-tables, and indeed every kind of table in use. For such purposes the planks should be cut so as to cross the rings as nearly in the direction BD as possible. We have no doubt that it is the knowledge of this property of wood, that renders the billiard-tables of some makers so far superior to those of others.

In wood that has the larger transverse septa, as the oak, for example, boards cut as BD will be figured, while those cut as AC will be plain.

Cause of pieces curving in the direction of their length.

47. There is another kind of contraction in wood whilst drying, which causes it to become curved in the direction of its length. In the long styles of framing we have often observed it; indeed, on this account, it is difficult to prevent the style of a door, hung with centres, from curving, so as to rub against the jamb. A very satisfactory reason for this kind of curving has been given by Mr Knight,† which also points out the manner of cutting out wood, so as to be less subject to this defect, which it is most desirable to avoid. The interior layers of wood, being older, are more compact and solid than the exterior layers of the same tree; consequently, in drying, the

* *Philosophical Transactions*, Part II. for 1817, or *Philosophical Magazine*, Vol. L. p. 437.
† Ibid.

Joinery. latter contract more in length than the former. This irregularity of contraction causes the wood to curve, in direction of its length, and it may be avoided by cutting the wood so that the parts of each piece shall be as nearly of the same age as possible.

Changes produced by the Weather. 48. Besides the contraction which takes place in drying, wood undergoes a considerable change in bulk with the variations of the atmosphere. In straight grained woods the change in length is nearly insensible,* hence they are sometimes employed for pendulum rods; but the lateral dimensions vary so much, that a wide piece of wood will serve as a rude hygrometer.† The extent of variation decreases in a few seasons, but it is of some importance to the joiner to be aware, that, even in very old wood, when the surface is removed, the extent of variation is nearly the same as in new wood.

It appears, from Rondelet's experiments,‡ that in wood of a mean degree of dryness, the extent of contraction and expansion produced by the usual changes in the state of the atmosphere, was,

in fir wood, from $\frac{1}{360}$ to $\frac{1}{75}$ part of its width;

and, in oak, from $\frac{1}{412}$ to $\frac{1}{84}$ part of its width.

Consequently, the mean extent of variation in fir is $\frac{1}{124}$, and, in oak, $\frac{1}{140}$; and, at this mean rate, in a fir board about 12½ inches wide, the difference in width would be $\frac{1}{10}$th of an inch. This will show the importance of attending to the maxims of construction we have already laid before the reader; for, if a board of that width should be fixed at both edges, it must unavoidably split from one end to the other.

Kinds of Wood. 49. The kinds of wood commonly employed in joinery are, the oak, the different species of pine, mahogany, lime-tree, and poplar.

Of the oak, there are two species common in this island; that which Linnæus has named *Quercus robur* is the most valuable for joiners' work; it is of a finer grain, less tough, and not so subject to twist as the other kind. Oak is also imported from the Baltic ports, from Germany, and from America. These foreign kinds being more free from knots, of a straighter grain, and less difficult to work, they are used in preference to our home species. Foreign oak is also much used for cabinet-work, and lately, the fine curled oak, that is got from excrescences produced by pollard, and other old trees, has been used with success in furniture. When well managed it is very beautiful, and makes a pleasing variety. It is relieved by inlaid borders of black or white wood, but these should be sparingly used. Borders of inlaid brass, with small black lines, give a rich effect to the darker coloured kinds.

Fir. The greater part of joiners' work is executed in yellow fir, imported from the north of Europe; white fir is often used for internal work, and American pine is much used for mouldings.

The forest of Braemar, in Aberdeenshire, furnishes yellow fir of an excellent quality, little inferior to the best foreign kinds.

Larch. For the general purpose of joinery, the wood of the larch tree seems to be the best; this useful tree thrives well on our native hills. We have seen some fine specimens of this wood from Blair Athol. It makes excellent steps for stairs, floors, framing, and most other articles.

Mahogany. Mahogany, in joinery, is used only where painted work is improper, as for the hand-rails of stairs, or for the doors and windows of principal rooms. For doors, it is not now so often used as it was formerly; its colour is found to be too gloomy to be employed in large masses. In cabinet-work it is almost the only kind employed for ornamental work.

Lime. Poplar. Lime-tree, and the different species of poplar, make very good floors for inferior rooms, and may often be used for other purposes in places where the carriage of foreign timber would render it very expensive. Lime-tree is valuable for carved work, and does not worm eat; but carving is, at present, seldom used in joinery.

For farther information on wood, in addition to the works referred to, the reader may consult Evelyn's *Silva*, Dr Hunter's edition; Duhamel, *Du Transport, de la Conservation, et de la Force des Bois*, Paris, 1767; Barlow's *Essay on the Strength and Stress of Timber*, 1817; Tredgold's *Elementary Principles of Carpentry*, Sect. X. 1820; and the article Dry-Rot in this *Supplement*.|| (H. H. H.)

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* Mr Ramsden and General Roy made some experiments on the expansion in length. See *Account of the Trig. Survey*, Vol. I. p. 46 and 49.

† See *Phil. Trans.* Lowthorpe's Abridg. Vol. II. p. 37.

‡ *Traité Théorique et Practique de l'Art de Bâtir*, article Menuiserie, Tome IV. p. 425, 1814.

|| The roof of Westminster Hall being now under repair, the opportunity has been taken to examine the wood of which it is constructed; and it is found to be of oak, and not of chesnut, as stated in the Article Dry-Rot, Vol. III. p. 684. The oak has been of an excellent kind, but is now much worm-eaten.

IONIAN ISLANDS.

Ionian Islands.

The Ionian Islands formed, lately, a small part of the Venetian dominions; and, by a fate somewhat singular, they have been raised to the rank of an independent power without any efforts of their own, at the very period which witnessed the extinction of Venice itself, with Genoa, Ragusa, and many other small states that had existed for ages. These islands, which are seven in number, exclusive of some small dependent islets, are situated on the western and southern shores of Greece, between 36° and 40° of north latitude; and between 19° 40′ and 23° 10 of east longitude. Four of them lie in a group opposite the entrance of the gulf of Corinth; other two, Corfu and Paxo, are situated about eighty miles north-west of this central group; from which Cerigo, the remaining island, lies about 150 miles south-east. The subjoined table gives a view of their extent and population; but the measurement can only be considered as approximations, as, we believe, no accurate map of all the islands has ever been published.

Modern Names.	Ancients' Names.	English Square Miles.	Population.	Authorities.
* Cephalonia,	Cephalenia,	500	60,000	Holland, 1812.
Corfu,	Corcyra. Phæacia,	270	60,000	Vaudoncourt, 1807.
Zante,	Zacynthus,	180	33,352	Williams, 1815.
Santa Maura,	Leucadia,	150	18,000	Holland, 1812,
Cerigo,	Cythera,	130	9,000	Do. 1811.
Theaki,	Ithaca,	60	9,400	Williams, 1815.
Paxo,	Paxus,	20	3,968	Do.
		1310	193,720	

According to this table, these islands contain about 150 persons to each square mile, a density of population nearly equal to that of the most populous countries of Europe, and very remarkable, considering how a great a proportion of their surface is too rugged to admit of any species of cultivation.

Climate and Diseases.

The climate of the Ionian Islands resembles that of the continent of Greece, except that the surrounding seas temper in a greater degree the extremes of heat and cold, and render the atmosphere more humid. Snow often falls during the winter, and lies on the high grounds, but very rarely in the plains. The winter rains sometimes bring with them great quantities of a reddish sand, which the people think has been transported from Africa by the south wind. Sudden and furious squalls are frequent, and the Sirocco, or hot wind, which occurs at certain periods, produces the usual effects, a dull headach, lassitude, and a sense of oppression. The harvest, which is generally in May on the continent, is here in June. Earthquakes are very frequent, though not often very destructive. In Zante, two or three sometimes occur in a month; it is observed that they are preceded by a peculiar state of the atmosphere, producing a feeling of heaviness, or a sulphurous smell, and that they are generally followed by rain. Malaria prevails in low situations in the autumnal months; and the itch, which is common in some parts, instead of being eradicated by medical means, is rather cherished by the people, from a strange notion that it is a preservative against malaria. In other respects, the climate is agreeable and healthy, and instances of remarkable longevity are known.†

Geology.

The rocks of all these islands belong to the same great calcareous formation which occupies the continent of Greece. They contain some, though very few, organic remains, and are disposed in highly inclined strata. The limestone, which is accompanied occasionally with beds of grey foliated gypsum, and with beds or masses of sandstone, is conjectured by Dr Holland to belong to the first flœtz limestone of Werner. At one spot, ten miles south of the town of Zante, are found a number of pitch wells, agreeing in their situation and appearance with the description given by Herodotus, two thousand four hundred years ago. They consist of small pools of

* The ancient geographers had a very imperfect idea of the extent of these islands. Strabo (Lib. x.) estimates the circumference of Cephalonia at 30 miles (300 stadia), instead of 100; that of Zante at 16 miles, instead of 60, and that of Ithaca at 8 miles, instead of 40. Pliny (Lib. iv.) gives 44 Roman miles as the circumference of Cephalonia, and 36 as that of Zante.

† Holland's *Travels in Greece*, p. 20, 37, 47; Williams' *Travels in Greece*, Letters xlix. l.; Turner's *Tour in the Levant*, I. 202, 204.

water, fed by springs, in a marshy tract near the shore, having their sides and bottoms lined with petroleum in a viscid state, which, by agitation, is raised to the surface in flakes. It is collected once a year, and the produce is about a hundred barrels. (Holland, Chap. i. and ii.)

Topography.

The surface of all these islands is so remarkably mountainous, that they do not contain a quantity of arable land nearly sufficient to afford corn to the population; and were it not that the vine, the olive, and the currant, enable them to extract a valuable produce from their rocks and declivities, they could support but a very small number of inhabitants. There is a considerable diversity, however, in the aspect and qualities of the surface of the different islands, which renders it necessary to speak of their topography separately. To begin with Corfu, the most northern, and the seat of the general government. This island, which is about 40 English miles long, and 15 in extreme breadth, lies opposite the coast of Albania, from which it is separated at one point by a strait two miles broad. A range of mountains occupies the centre of this island, the highest summits of which, Mount Kassopo, must be nearly 4000 feet high, since the coast of Italy, at 80 miles distance, is visible from it. The island is rather bare of wood, and not abundant in good pasturage. Wheat is raised in some low situations near the coast; but though called *fruitful* Corcyra by Dionysius, and celebrated for its riches by other ancient authors, its inhabitants depend chiefly on importation for corn, which they procure in exchange for their wine, oil, and salt. The capital, also named Corfu, which lies on the east side of the island, contains about 15,000 inhabitants, and is a pretty strong place. This island is the Phæacia of Homer. A small bay, five or six miles south of the capital, is conceived to be the Alcinus Portus, where Ulysses, after his shipwreck, met with the daughter of Alcinous; and Fano, a small rocky inlet seven or eight miles in circumference, lying twelve miles off the north-west coast of Corfu, is the island of Calypso.*

Paxo, the next in order, which is about seven miles long, and three broad, lies eight miles south-east of Corfu, and twelve miles west of the coast of Albania. Its surface is highly beautiful, much inclosed, and nearly covered with olive trees. Its capital, St Gago, contains a great proportion of the population, amounting to 3948 persons, who depend very much on trade for their subsistence. Antipaxo, an inlet five or six miles in circumference, and inhabited by a few fishermen, lies near it. (Vaudoncourt, Chap. xi.; Williams, Let. xlviii.)

Leucadia.

Santa Maura, about twenty miles long, and eight or nine broad, lies so close to the coast of Greece, that it was formerly joined to it by an isthmus. It is sixty miles south-east from Corfu, three miles from Ithaca, and five from the nearest point of Cephalonia. The surface consists of a range of limestone mountains, which rise to the height of nearly 2000 feet, and terminate on the south-west, in the celebrated Leucadian promontory, where unhappy lovers, following the example of Sappho, came to cure themselves of an unrequited passion. The cliff is not very lofty, though sufficiently so for the purpose to which it was applied. It is still the custom of the neighbouring mariners, when passing, to throw in a small piece of money, as an expiatory offering. The island contains very little level surface. Its principal products are olives and vines; and salt is made on the coast. The capital, also named Santa Maura, containing 5000 inhabitants, is situated at the northern point of the island, where it is separated by a narrow channel from the continent. The ancient name Leucadia, or, as it is now pronounced, Lefcadia, is still known among the inhabitants, and ought to be used to distinguish the island from its capital. (Holland, Chap. iii.; Vaudoncourt, Chap. xi.)

Ithaca.

Theaki, the ancient Ithaca, the regal seat of Ulysses, consists merely of a narrow ridge of limestone, seventeen miles long, and four in extreme breadth, rising into rugged eminences, with scarcely a hundred yards of continuous level surface in its whole extent. Near the middle, it is intersected by a deep bay, which penetrates four miles inwards. Upon this bay the town of Vathi, the capital, is situated, containing 2000 inhabitants. The chief produce of the island is currants; but it yields, also, a small quantity of oil and wine, the latter much esteemed. The grain raised suffices only for three months' consumption. On a hill near Vathi are some massive ruins of ancient walls, with a number of sepulchres, which are supposed to mark the site of the capital of Ulysses. Near the south-east end of the island is a cliff called Koraka at present, and supposed to be the rock Korax, mentioned in the Odyssey, and under it, in a secluded and picturesque spot, is a fountain, conceived to be that of Arethusa, where Ulysses met the faithful Eumæus. The island is still named Ithaca by the more intelligent natives, which is corrupted into Theaki by some of the lower classes. Between Ithaca, Santa Maura, and the continent, are situated four small rocky isles, named Meganisi, Calamo, Atako, and Carto, besides several minute islets, of little or no importance. (Holland, Chap. iii.)

Cephalonia.

Cephalonia, three miles from the nearest point of Ithaca, is the largest of all the Ionian Islands. Its greatest length is forty English miles, and greatest breadth twenty-four. A lofty chain of mountains, the Mount Ænos of antiquity, nearly 4000 feet high, occupies the centre of the island, and sends off branches to all the principal promontories. The wood which covered a part of these hills was wantonly burnt, about twenty years ago, during some internal disturbances. A deep gulf penetrates far inland from the south side of the island: and, upon the east side of this gulf stands Argostoli, the capital, containing 4000 inhabitants. Lixuri, the only other town, contains 5000 inhabitants; and there are, in the island, 175 villages. (Turner, 192.) The surface of Cephalonia is generally rocky; the soil thin, and less fertile than that of Zante. Its chief productions

* *Memoirs of the Ionian Islands*, by General Guilliaume De Vaudoncourt, translated by Mr Walton. Chap. xi.

Ionian Islands.

are currants, oil, and wine. Some ruins of Cyclopian walls mark the site of the city of Samus, mentioned by Homer; and there are some remains of Krani, Pronos, and other ancient cities. Vestiges of the altar of Jupiter Ænesius are said still to exist on the top of Mount Ænos. (Holland, Chap. ii.)

Zante.

Zante, which lies ten miles south from the nearest point of Cephalonia, is about sixty miles in circumference. Unlike the neighbouring islands, its surface consists chiefly of a large plain, reaching from the southern to the northern coast, but bounded on the east and west sides by calcareous ridges, about 1200 or 1300 feet high. This plain, covered with vineyards and olive groves, with only a few spots in tillage, presents the appearance of luxuriant fertility, and has procured for the island the title of the "Garden of the Levant." The capital, Zante, situated on the east side of the island, contains 18,000 inhabitants. Zante contains very few antiquities; and though smaller, and inferior in population to some of the other islands, is the richest of them all. (Holland, Chap. i.)

Cerigo, the ancient Cythera, the last of the seven islands, is about 50 miles in circumference, and is situated near the south coast of the ancient Laconia, 150 miles from the nearest of its Ionian confederates. The face of the island is mountainous, and though reported to be the birth place of Venus, it is rugged, barren, and destitute of beauty. Its productions are similar to those of the other islands, but it is less commercial, and abounding more in pasturage, it raises a considerable number of sheep and cattle.*

Agriculture.

Landed property, in all the islands, is in the hands of a comparatively small number of persons, who form a proud, oppressive, and rapacious aristocracy. The Venetian senate, while it possessed these islands, kept all the more solid advantages to its own citizens, but bestowed titles, which cost nothing, profusely upon the petty insular chieftains; and nobles, destitute of education, honour, or property, are as common here as in Italy. The lands are generally let by the year, the tenant paying half the produce to the landlord,—a species of tenure almost universal in rude countries. In Cephalonia, where property is pretty much divided, the largest proprietor has not above L.800 or L.900 a-year; but in Zante there are estates of more than double this value. (Holland, 36.) In the rural economy of the Ionian Islands, corn is an object of secondary importance, and farming is conducted on the rudest principles. Barley, wheat, maize, and oats, are cultivated, but the quantity of grain of all kinds raised does not exceed one-half, and in some of the islands is not one-third, of the annual amount of consumption. Of the corn raised in Ithaca, one-tenth is wheat, and nine-tenths barley. The returns of the former are estimated at 6 or 7, and of the latter at 8 or 9 for 1. (Williams, *Appendix*, No. iii.) Flax and cotton are cultivated to a small extent in several of the islands. Cephalonia is computed to yield of the latter 100,000 pounds annually, of an excellent quality. (Vaudoncourt, 438.) The number of oxen, sheep, and goats, is considerable in the islands less adapted to the cultivation of the currant, vine, or corn: but others, such as Zante, have very few, and all are partly supplied with cattle and poultry from the Morea. Milk cows are rare, the milk of goats being preferred for ordinary use, as well as for the manufacture of cheese. The produce of wax and honey in some of the islands is very great. Cerigo is stated to have had 1280 hives in 1811, and 60,000 or 80,000 pounds of honey of an excellent quality are collected annually in Cephalonia. (Vaudoncourt, 437. Holland, 43.)

Olives.

The cultivation of vines and olives is an object of greater attention to the inhabitants than that of corn, and is more skilfully conducted. Nine sorts of olives grow in Zante, differing considerably in their qualities. The fruit begins to ripen in November, but does not fall off till towards the end of December, or the beginning of January. This is the time when they are gathered, but in some places they are plucked with the hand, and not allowed to fall. They are carried to the mill in April, but the harvest is not entirely at an end till the month of May. The oil is carried to the sea ports in sheep skins. Olives are cultivated to the greatest extent in Corfu, where the produce collected every two years amounts, in middling seasons, to 700,000 jars, or 90,000 barrels,† annually. Zante produces about 30,000 barrels; Cephalonia, 30,000; Leucadia, 3000; Paxa, 8500; and Ithaca, 1500. Including Cerigo, the annual produce of olive oil will not be much less than 200,000 barrels. While the Venetians were masters of the island, and retained a monopoly of the oil trade, the price averaged from 40 to 43 livres of Corfu (6s. 8d. to 7s. 2d.) *per* jar; but in 1802 it rose to 60 livres (10s.); and in 1807 (a dear year) was 17½ dollars *per* barrel, or about 19s. *per* jar. The oil is of four different qualities, the finest of which is fit for the table, and the other three species are used in various manufactures.‡

Grape.

Wine is made in all the islands to a small extent. In Zante, forty species of grape are distinguished, but the small black species, known under the name of currants, is the only kind extensively cultivated. Ithaca produces about 12,000 barrels of wine annually, of a quality superior to that of the other islands, and which sells about 20 dollars *per* barrel. Cephalonia produces from 30,000 to 35,000 barrels of good wine. Zante yields only about 4000 barrels; Leucadia 1000. The produce of the other islands is not known.§ Oranges, lemons, and citrons, are raised in several of the islands, both for domestic use

* Galt's *Voyages and Travels*, 1812, p. 137. Holland, Chap. iii.

† The barrel rather exceeds the millerole of Marseilles, or 59.7 *litres* (Vaudoncourt); and, according to Williams, is equal to 128 English pints. These accounts agree, and the barrel may therefore be considered as one-fourth of a hogshead.

‡ Vaudoncourt, Chap. xii. Holland, Chap. ii. and iii. Williams, p. 173, and *Appendix*, No. iii. Walpole's *Memoirs relating to Turkey*, p. 288.

§ Holland, p. 22. Vaudoncourt, Chap. xii. Williams, *Appendix*, No. iii.

Ionian Islands.

and exportation; and salt is supplied for exportation in large quantities from Corfu and Leucadia.

Currants.

The currant is the staple produce of Zante, where it occupies nearly two-thirds of the cultivated land. It is raised also in Cephalonia and Ithaca, but does not succeed in Corfu or Leucadia. Its culture is conducted with great neatness, and when the flower is out, the aspect of the great vineyards is singu rich and beautiful. It thrives best in a deep soil, at the foot of mountains. The currants are gathered about the beginning of September, somewhat sooner than other grapes; are spread abroad for eight or ten days, and are usually ready for packing by the end of September. The annual produce of Zante is from 7,000,000 to 8,000,000 pounds, the price of which in the island varies from 14s. to 18s. *per* hundred weight. Cephalonia yields from 5,000,000 to 6,000,000 pounds, and Ithaca 500,000. The whole produce of the Ionian Islands in this article may therefore be estimated at 13,000,000 or 14,000,000 pounds. (Holland, Chap. ii. and iii. Vaudoncourt, chap. xii.)

Annual Produce.

Mr Williams gives the estimated value of the annual produce of the three islands Zante, Paxo, and Ithaca, in corn, wine, oil, currants, honey, and flax, the chief productions, but excluding minor articles, such as cheese, fruit, &c. The estimates appear to be official, and as they are probably deduced from surveys made for the purpose of taxation, they are entitled to some degree of confidence; but it would have been more satisfactory had he stated upon what basis they were formed. The annual produce of Zante, in 1815, is stated at 1,066,745 dollars, or L.234,000; that of Ithaca, 98,896 dollars, or L.22,000; that of Paxo, 104,018 dolars, or L.23,000. These three statements give, on an average, L.6 Sterling of produce for each inhabitant, but, as some of the other islands are less favourably situated, L.5 is probably high enough, as a mean, and if we compute the annual value of the produce of the whole on this principle, it will be L.970,000 (Williams, 72-183, and *Appendix*, No. iii.), or, in round numbers, L.1,000,000 Sterling, and this is exclusive of what is derived from commerce and the mechanic arts.

Commerce.

The situation of the Ionian Islands gives them naturally, and in some measure necessarily, a commercial character. Their position, near the coast of Greece, where the tyranny of the Turks renders property so insecure, tends to make them a medium of communication with that country, and an entrepot for its commodities. The narrowness of their territories, which obliges them to import provisions, and the peculiar nature of the soil and climate, which are better adapted to raise other productions than corn; their insular situation, and long connection with the Venetians,—all dispose them to engage largely in commercial transactions. The trade of the islands, considering their extent and circumstances, is, in truth, considerable, and has increased greatly since it was freed from the shackles imposed upon it by the monopolising spirit of the Venetians. The exports consist of olive oil, currants, wine, honey, wax, salt, soap, oranges, lemons, tobacco, cheese, &c. The imports are corn, woollen, cotton, and linen goods, velvets, cured fish of various kinds, sugar, coffee, iron, lead, dye-stuffs, paper, drugs, spices, &c. Zante, in 1815, exported goods to the value of 591,000 dollars. Cephalonia has 250 vessels of various sizes. The little island of Paxo has 56 vessels, and exported goods to the value of 96,000 dollars in 1815. Ithaca, in 1815 or 1816, had 2598 tons of shipping, which, with boats belonging to the Island, employed 823 men, and 74,360 dollars of capital. The little island of Cerigo, the least commercial of the whole, had, in 1809, only about 25 vessels, nearly all boats, employing 230 men. The number of Ionian vessels that trade with Turkey was estimated, in 1816, at 250, of which 200 were under their own flag, and 50 under the Russians. We should probably not err much if we estimated the exports of the whole islands at something more than double those of Zante, or about one-third of the computed gross produce of the land, namely, L.300,000 Sterling. A great number of their vessels trade with the Russian ports in the Black Sea for corn, others with Malta, Greece, Italy, France, and Spain. In the intercourse between the islands which lie near one another, a species of long slender boat is used, named *Monoxylon*, made of a single piece of wood, preserving both the form and the name of the vessels used in earliest and rudest stage of Greek navigation. (Potter's *Antiquities*, Book iii. Chap. xiv.) The interest of money, in common cases, is 10 *per cent.* The merchants are generally poor and unenterprising, but a few individuals have accumulated considerable fortunes. (Williams, Vol. II. 183.) One individual, a nobleman is mentioned, who is said to possess a million of dollars. If these islands continue to enjoy tranquillity, and if their internal economy is improved, it is probable they will attract a considerable part of the trade which now centres in Salonica, Hydra, Spechia, and other Turkish ports, where the merchants are exposed to loss and vexation from the rapacity and violence of the Turkish government.*

Public Revenue.

The public revenue arises from a tithe or impost on the various species of produce raised within the country, grain, wine, oil, flax, and cattle; from a tax on hearths or inhabited houses, a tax on oil presses, and from duties of customs on articles exported and imported. The produce of these various duties, in 1815, was as follows:

REVENUE.

	Eventual Revenues.	Fixed Revenues.	Totals.
	Dollars.	*Dollars.*	*Dollars.*
Zante,	71,779	83,015	154,795
Cephalonia,	79,807	8,387	88,194
Leucadia,	2,011	36,271	38,283
Ithaca,	1,976	6,693	8,669
Paxo,	240	6,717	6,957
Cerigo,	130	5,570	5,700
Parga,	35	1,623	1,667
	155,978	148,285	304,265

* Holland, Chap. i. ii. iii.; Vaudoncourt, Chap. xii.; Turner, Vol. III. Appendix.

Ionian Islands

EXPENDITURE.

	Dollars.
Zante,	102,688
Cephalonia,	64,174
Leucadia,	34,973
Ithaca,	5,403
Paxo,	6,107
Cerigo,	1,956
Parga,	4,267
	219,568 equal to L.48,500.
Revenue,	304,266
Surplus,	84,698

(Williams's *Travels, Appendix*, Nos. ii. and iii.)

This small expenditure appears to include only the charges of the civil government, and perhaps not the whole of these. The body of 3000 troops, chiefly British, kept in the islands, would alone evidently absorb a larger revenue. And although it was fixed by the constitution, that the islands should defray the expence of their own military establishment, it appears in point of fact, from a Parliamentary paper (dated 25th February 1820, No. 87), that the British Government incurred an expence of L.145,203 in the Ionian Islands in 1817, and L.120,045 in 1818, for purposes chiefly military, but partly civil. It is difficult to conceive, that there can be any British objects in that quarter requiring such an expenditure, or that the money has been advanced provisionally, to be afterwards repaid, since the revenues of the islands must now be on a permanent footing. There remains but one admissible supposition, that these islands are to form a permanent burden on the people of Britain; and yet, at a period when our own expenditure presses so heavily, it seems little less than infatuation, to increase our difficulties gratuitously, by relieving a distant country less heavily taxed of the expence of defending itself.

Constitution.

The existing constitution of the Ionian Islands, which was sanctioned by its own Legislative Assembly in May 1817, vests the supreme power in the High Commissioner, the Senate, and the Legislative Assembly, which have jointly the title of the Parliament of the Ionian Islands. The Legislative Assembly consists of 40 members, of whom 29 are elective, and 11 *integral*, and all must belong to the class of *Synclitæ*, or nobles, the common people having nothing to do with the laws, but to obey them. The 11 *integral* members consist of the president and members of the old Senate, with the regents or governors of the five largest islands—all of whom are substantially, though not directly, nominated by the High Commissioner. The 29 elective members are chosen by the nobles of the different islands, from prepared lists sent down by the Primary Council, in the following proportions:

Corfu,	7
Cephalonia,	7
Zante,	7
Leucadia,	4
Ithaca,	1
Cerigo,	1
Paxo,	1
	28

And each of the three last in rotation elects a second member, which makes 29. The Legislative Assembly elects its own officers; fixes the amount of the supplies; and all its members have the power of proposing new laws or regulations.

The Primary Council, mentioned above, which acts only during a dissolution of Parliament, consists of the president and members of the last Senate, with five members of the last Legislative Assembly, nominated by the High Commissioner.

The Senate consists of five members and a president, the latter appointed directly by the High Commissioner. The five members are elected by the Legislative Body out of its own number, and confirmed by the High Commissioner. If he negative the election of an individual, another is elected; and if he negative the second also, the vacancy is filled up by his nominating two individuals, of whom it then falls to the Legislative Body to choose one. This Senate is an executive council, as well as a deliberative body. It nominates most of the officers under the general government, such as judges, regents, archivists, &c. but its nominations must be confirmed by the High Commissioner. It makes regulations during the recess of the Legislative Assembly, which have, *pro tempore*, the force of laws; and it deliberates and decides upon all propositions submitted to it by the High Commissioner, or sent up from the Lower House, but its members have not a power to initiate legislative proceedings.

The Legislative Assembly and the Senate are elected for five years, but may be dissolved at the lapse of a shorter period by the High Commissioner. The appointments of judges, regents, and other officers, are also for five years.

The High Commissioner is nominated by the protecting sovereign. He appoints the president of the Senate, who has the initiative of all proceedings in that body. He appoints a resident for each of the islands, who has the power of suspending any proceeding of the local government. He nominates a number of officers, and has a negative (direct or indirect) upon the appointment of most of those whom he does not nominate. He has a *veto* on all propositions which have passed the two houses; but though he give his sanction to any specific measure, there is still another *veto* behind, lodged in the King of Britain, who may annul the proceeding at any period within one year of its enactment.

Each island has a local government, consisting of a municipal council of five members, selected by the regent (with the approbation of the High Commissioner), out of a list of ten, chosen by the *synclitæ*. And besides these, there are five active functionaries, —a regent, secretary, fiscal, archivist, and treasurer, —all, except the last, nominated by the Senate, and confirmed by the High Commissioner.

The judicial power is lodged in a supreme court at the seat of government, consisting of four ordinary, and two extraordinary members. Of the former, two are native Ionians, named by the Senate, and approved of by the Commissioner; and two directly named by the Commissioner, may either be British subjects or Ionians. When these four are equally divided on any question, reference is made to the two extraordinary members, who are the High

Ionian Islands.

Commissioner and President of the Senate. Subordinate to this supreme court are twenty-one inferior tribunals, that is, a civil, a criminal, and a commercial tribunal in each island. And under these, again, are justice of peace courts, for minor offences, and small civil suits. Besides the general appellant jurisdiction, which the supreme court has over the local tribunals, it is empowered to send a delegation of its members on circuit on special occasions, when thought necessary by the Senate and High Commissioner. The number of judges in the local courts is not fixed by the constitution.

The *Sanita*, or Health Establishment, is under the sole direction of the High Commissioner. The army, consisting entirely of the troops of the protecting sovereign, is also under the orders of his representative. The expence of the army is to be defrayed by the islands, if the number does not exceed 3000 men. There is, besides, a national militia, commanded by native officers.

Individuals, or bodies of men, have the right of representation or petition to the protecting sovereign or his ministers.

A printing press is to be established at the seat of government, under the "immediate control of the Senate and High Commissioner," and "no other printing press shall be set up and employed, without the previous licence of the Senate, and the sanction of his Excellency."*

We have described this constitution more in detail than its importance merits, for, without exaggeration, it may certainly be pronounced to be the very worst among the numerous plans of representative government framed within the last thirty years. It is, in fact, little else than a compact between the British government and the petty despots of the islands, settling in what proportions the power, patronage, and taxes of the country are to be shared between them The rights and interests of the mass of the people, for which even the German princes in their new constitutions profess a decent respect, are not the object of one single stipulation in this long and detailed instrument.

Manners and Customs.

The style of building in the Ionian Islands is chiefly Italian, and the interior of some of the cities shows great neatness. The streets are generally narrow; the houses, some of wood, some of stone, are three, four, or even five stories high, with open latticed windows. The shops are tolerably well supplied with manufactured and colonial articles, and the persons employed in them display more alertness and civility than the indolent shop-keepers of Spain, Portugal, and Sicily. The churches, as in Greece, are disproportionately numerous. Some of them have steeples, others have merely an elevated facade. The population, in consequence of the long dominion of the Venetians, is, in manners and habits, as well as in costume and language, intermediate between the Greek and Italian character. Though enjoying more liberty, they are, in some respects, inferior to the continental Greeks. Their exterior is less dignified, their manners more corrupt, and they show less capability of again becoming a people. This degradation of character may be attributed chiefly to the vicious nature of the Venetian government. The governors and judges whom it sent out to the islands were very often nobles of decayed fortune, who undertook the duties as a speculation to retrieve their affairs. Bribery was practised openly; toleration for a crime might easily be purchased; and the laws, imperfect in themselves, were rendered wholly null by the corruption of the judges. The petty insular aristocracy separated into factions, which trampled on the laws and oppressed the people. The Venetian government, by a detestable policy, encouraged their feuds, to prevent their combination, and exposed the country to all the evils of a continued civil war. As happens in all countries where justice is denied by the laws, private revenge and assassination prevailed to a frightful extent. In the island of Zante alone, with 33,000 inhabitants, the number of assassinations sometimes exceeded one for each day of the year. Many of the nobles, indeed, kept assassins in their pay, and others of them fitted out privateers for the trade of general piracy, in which the vessels of their own countrymen were not spared. These nobles are generally educated in Italy, and speak the Italian language, but in knowledge and refinement they are scarcely on a level with the middle ranks in England. The lower classes, like the continental Greeks, use the Romaic language, but with a larger mixture of Italian words; and, like them, too, they are active, ingenious, adroit, loquacious, subtle, and intriguing. Physic and law are favourite professions, and the better order of lawyers and physicians, who have been educated in Italy, form the most intelligent part of society. The clergy are extremely numerous, but less informed, and inferior in respectability to the two former classes. They were very active in resisting some of the reforms attempted by the British. When Major du Bosset introduced the culture of the potatoe in Cephalonia, they laboured to persuade the peasants, that this was the very apple with which the serpent tempted Adam and Eve in paradise. (Holland, 41.) The women, as in Greece, are almost entirely secluded from society, and are, of course, ignorant, superstitious, and feeble in their character. (Holland, Chap. i. ii.) In all that regards the intercourse of the sexes, much laxity of morals prevails, but the poor are less corrupted than the rich. Most of the nobility have mistresses, and the laws allow them to legitimate the issue of these connections by a subsequent marriage. A sort of agreement is not unfrequent, by which a young woman is made over by her parents, with her own consent, to her admirer at a stipulated sum. This species of concubinage, which frequently terminates in marriage when the girl is respectable and has children, is, on other occasions, the cause of much infidelity and unhappiness. (Williams, *Letters* xlvii. xlviii.) In the country the Greek dress is generally used, though with some modifications; but in the town the Italian dress prevails, as well as the

* *Parliamentary Paper*, 18th March 1818, No. 132.

Ionian Islands.

Italian fashions in the style of furniture, and in the modes of social intercourse. It was a leading object in the policy of the Venetians, indeed, to extinguish the national spirit of the Ionians, to deprive them of the means of education, and to brutalise their character by every method in their power, that they might convert them into passive instruments of their sovereign* will. But, after three centuries of such ...licy, there can be no doubt, that the Venetians ...t more by the odious nature of the innovations at...pted than they gained in security by the result. ...audoncourt, Chap. ii. xii.)

Religion.

The attachment of the Ionians to the Greek religion, however, has effectually resisted the innovating spirit of their masters. The Catholic worship is tolerated, but the national faith has lost little of its influence upon the minds of the people. Each island has its patron saint, in the efficacy of whose intercession the people are taught to believe. The British authorities humour the popular superstition in this particular; and, in Corfu, the patents from the health office bear to be "in the name of God, and by the intercession of Saint Speridion." Ceremonies and processions, with fasts, frequent and severe, take the place of piety and good works. A ruffian, engaged in a project of assassination, has refused to taste animal food in the season of the fast. As in many other countries, the lower orders are comparatively strict in their religious observances, while indifference and infidelity are common among the higher classes. But, if religion is in a low state, it is not from the want of priests and churches, the number of which is out of all proportion to the number of inhabitants. The little island of Paxo, with 4000 inhabitants, has 36 churches (Williams); and Cerigo, with 9000 inhabitants, is said to have the incredible number of 260 churches, or chapels, and 165 priests. (Holland.) These swarms of priests are a sort of privileged mendicants. They are, in general, too illiterate to understand religion themselves, and, of course, they are incapable of teaching it to others. But as they derive their subsistence chiefly from fees for absolution, and from gifts and offerings, they find it necessary to support their influence, by filling the minds of those under their care with a thousand idle or pernicious superstitions. Besides the secular clergy, there are a number of regular religious in convents scattered over the islands, but of their number or condition we have seen satisfactory account. (Holland, Chap. i. and Williams, *Letters* xlvii. xlviii.

History.

The Ionian Islands make no considerable figure in ancient history. Cephalonia, Zante, Ithaca, and Santa Maura (then joined to the continent), formed part of the kingdom of Ulysses; and if we may judge of their condition, from the armament which their prince carried with him to the Trojan war, we should conclude that they were less populous and less improved than the continental parts of Greece. These islands, along with a part of the opposite continent, furnished only twelve ships, while the little island of Salamis, not one-twentieth part of the extent, sent as many. (*Iliad*, L. ii. 631.) They were then, as at this day, under power of a number of petty chieftains; and it is a proof of the accuracy of Homer's geographical knowledge, that their relative numbers, as stated by Telemachus (*Odyss.* L. xvi. 249), correspond tolerably well with the actual extent and importance of the islands, Cephalonia (Samus) having 24, Zante 20, and Ithaca 12. At a later period, the Corinthians planted colonies in Leucadia and Corcyra, and probably in some of the other islands over which they maintained some degree of authority. The Leucadians sent 800 men to fight the Persians at Platea, and the Cephalenians of Pale 200. (Herodotus, L. ix.) The Corcyreans, from their favourable situation, rapidly became strong by sea, and not only shook off their independence on the parent state, but committed depredations on the commerce of the other Grecian cities, till the Athenians, shortly after the battle of Marathon, attacked them and broke their naval strength. The jealousy between the Corcyreans and Corinthians, about forty-five years later, led to hostilities between the parties, in which the Athenians were drawn in to take the part of the former, and the extension of this petty quarrel at length produced the celebrated Peleponnesian war. The Corcyreans had 120 triremes when the contest began, and were the second naval power in Greece. (Thucydides, L. i. Xenophon, *Hist.* L. vi.) The Zacynthians also, who were a colony of Achæans, and the Cephalenians, were generally leagued with the Athenians, and afforded them assistance in the expedition against Syracuse. The Leucadians we find adhering to the Corinthians. (Thucydides, L. ii. iii. vii.) When the Spartans invaded Corcyra, about thirty years after this, the country is represented as richly cultivated, finely planted, and abounding in wealth and luxury. (Xenophon, *Hist.* L. vi.) Cerigo, from its situation, was almost always an appendage to Laconia. These islands, with the rest of Greece, at length fell under the dominion of the Macedonians. In the wars between Philip and the Etolians, however, we find the latter occasionally making use of the naval forces of the Cephalenians. (Polyb. L. iv. 6.) When the Romans established themselves in Greece, these isles, from the position between that country and Italy, were early occupied; and Corcyra is often mentioned as a station of their fleet in their subsequent wars. (Livy, L. xxiv. xxxii. xxxvi. xxxviii.) They continued to follow the fortunes of the Roman empire nearly to the latest period of its decline; and they suffered from the ravages of the Goths, Wallachians, and other barbarous tribes, till they fell into the hands of the Venetians, some of them in the twelfth, and others in the thirteenth century. This nation also conquered various maritime towns on the continent of Greece, of which, as well as of some of the islands, the Turks occasionally dispossessed them. The Venetians first acquired the Morea in 1417, and lost it finally in 1715. The Turks, at this latter period, took Cerigo, and besieged the city of Corfu; but the Venetians becoming masters at sea, regained Cerigo, repulsed the Turks from Corfu, and took several continental towns.* The treaty of

* *Abregé Chronologique de l'Histoire Ottomane*, par M. de Lacroix, i. 172, ii. 700.

Ionian Islands.

Campo Formio (October 1797), which annihilated the state of Venice, transferred to France the Ionian Islands, with their continental dependencies, consisting, at that time, of five seaport towns, Butrinto, Gomenitza, Parga, Prevesa, and Vonitza. When the invasion of Egypt led to hostilities between France and Turkey in 1798, Ali, Pasha of Albania, besieged and took Prevesa and the other continental towns, except Parga; and the islands having been reduced by the fleets of Russia and Turkey, were erected into an independent state, by a treaty between these powers, dated 21st March 1800. They were placed under the protection of the Porte, as its vassals, and were to pay it an annual sum of 75,000 piastres. (*Annual Register*, 1800. *State Papers*, p. 278.) The towns on the continent were ceded to the Porte, of four of which it obtained possession. But the inhabitants of Parga, dreading the merciless disposition of the Albanian Pasha, took up arms in their own defence, and, favoured by the strength of their position, repelled his assaults. A constitution was given to the republic in 1803, which it is unnecessary to describe, as it has since been superseded. It is sufficient to say, that it was drawn up by Russian ministers of state, ignorant of the circumstances of the islands, and contained such a specimen of republican principles, as might be expected from Muscovy. The war between Russia and the Porte in 1806 led to the occupation of the Ionian Islands by the former, and by a secret article of the treaty of Tilsit (June 1807), they were made over to France. The French, during their first occupation of the islands, had abolished the use of the Italian language in public acts, and re-established the Romaic. Connecting these possessions with his projects against Turkey, Napoleon was anxious to revive the national spirit of the Greeks. A Romaic newspaper was set on foot (and has been continued by the British); establishments for promoting scientific education were projected, and to crown these schemes by a piece of French extravagance, the reckoning by olympiads was introduced. These projects held out only a distant prospect of good, but the expence of the large military force stationed by the French in the islands was a real and immediate grievance. In 1810, a British force, under General Oswald, took possession of Zante, Cephalonia, Ithaca, and Cerigo, almost without opposition; and of Santa Maura after some resistance. Corfu and Paxo having garrisons too strong to be attacked, were merely subjected to a maritime blockade, which, however, could not be so rigorously enforced as to reduce them. They were surrendered to the British after the general peace in 1814. The Turkish government now renewed its claim to Parga, under the treaty of 1800, though that claim had been virtually set aside by subsequent circumstances. That government had entirely failed in affording the Ionian Islands the stipulated protection, since it had suffered first the Russians, and afterwards the French, to occupy them with a military force. It had been a party to subsequent treaties, by which this had been in substance annulled. The original treaty bound the Turks to protect the Parguinotes; and it was now obvious, from the fate of the other towns, and from the feelings of the inhabitants, that its surrender would be equivalent to a warrant for its destruction. Lastly, the British had no right to make over Parga to the Turks, for it was not reduced by our arms, but its inhabitants put themselves under our protection by a voluntary act, and upon the express condition that their town was to remain attached to the Ionian republic. From ignorance or inattention to these circumstances, however, the Congress of Vienna had resolved that Parga should be given up. And, in obedience to the mandate of this conclave of sovereigns, the soldiers of Ali took possession of the bare walls in June 1819; the inhabitants, amounting to 5000, having, to a man, emigrated to Paxo and the other islands, after receiving a very inadequate indemnity for the loss of their property.*

General Remarks.

The Ionian Islands, either as a separate state or as a dependency of Great Britain, are of little importance. The interest felt in their fate is founded on classical associations, and on the means they are supposed to afford for restoring the Greeks to their existence as a nation. But, under the political system established in the islands, the hopes raised on the latter ground appear to us to be almost entirely chimerical. The Ionian Greeks must be enlightened and improved themselves before they can become useful auxiliaries in the work of enlightening and improving the rest of their countrymen, who are groaning under Turkish tyranny. To effect this change in their character, and to create and nourish a national spirit, three things are indispensable, with which their new constitution leaves them entirely unprovided—a system of national education, a free press, and a free government. The British ministry, in patronising a plan for erecting a university in the islands, has begun its operations at the wrong end. The first and most indispensable step is to increase the small number of schools at present in existence, till they are sufficiently numerous to afford common education to the whole population. A university may then be useful; but the Greeks can never be emancipated by giving a learned education to a few individuals, while the mass remain sunk in ignorance and superstition. On the other hand, when a moderate degree of knowledge is generally diffused, ardent spirits will emerge from the multitude, and rise to eminence by their native force, while their countrymen will then be better prepared to reap advantage from their exertions. At present a well informed Greek finds his acquisitions useless, and can only mourn over the hopeless humiliation of his country. Again, without a free press in their native language, the Greeks cannot receive that political instruction which is necessary to fit them for becoming once more a nation; knowledge cannot be rendered popular, nor of course useful; and a university will become a mere establishment of sinecures, or an engine for propagating corrupt and servile doctrines, worse than ignorance it-

* *Edinburgh Review*, No. LXIV. Art. I.; Holland's *Travels*, Chap. ii. Treaty between Britain and Russia, 5th November 1815.

self. It is no solid objection that the Ionian Greeks are mere children in literature, and could not make a discreet use of the press. Feeble as their powers may be, they will continue children still, if they do not use them. Their own blunders will often be better instructors than the mature wisdom of others, if their minds are kept in a state of pupillage. With general education, and a free press, should be conjoined the invigorating spirit of a popular government—not a government bottomed on close corporations and privileged classes—but one broadly republican in its forms and spirit. Whatever may be the defects of such a government, it is calculated, beyond all other human inventions, to call forth the energies of man. It was this inspiring power that carried forward the ancient Athenians in their brilliant career of improvement and glory; that raised the Italian and Dutch republics to sudden wealth and power; and that is now giving a new aspect to the vast continent of North America. The people are ignorant and disorderly, but probably not more so than the Athenians in the time of Solon, or the Italians in the thirteenth century, who were, nevertheless, found capable of supporting republican institutions. The errors into which their ignorance might have led them, would most probably have soon cured themselves. And, at any rate, the Ionians are in that precise situation, which would have divested such institutions of the dangers usually supposed to attend them. The natural influence of the British Government, as the protecting power, would have moderated the violence of factions, and preserved the government stable amidst their struggles. Had a free, active, and enlightened community been raised up in these islands, speaking the language of Greece, and almost in contact with the country, the emancipation of the continental Greeks would not only have been secured, but so much light would have been diffused among them, and such a good model set before them, that they would have been in a condition to make a wise and safe use of their independence, and step at once into the enjoyment of a free constitution. As matters have been ma[naged], however, it would be foolish to expect, that these islands will contribute in any degree to the liberation of the Greeks. Exclusive of the prerogatives of the High Commissioner, all power is vested in the nobles, who are universally described as the most worthless part of the population. Votes alone will command office, and the mass of the people who have no votes to give, though not expressly, will yet be substantially excluded from every place of trust and honour, and kept in the same state of vassalage as under the Venetians. Public burdens will naturally accumulate, because those who impose taxes have a separate interest from those who pay them; and abuses will multiply, because the nobles, hanging on the government for support, are gainers by a system of waste and profusion. A free press, which would have corrected some of these evils, has been jealously guarded against by the constitution; and as for the right of petition, in a government so constructed, it must be an empty name. In all probability, then, the Ionians will consider the Turkish practice of insurrection as the only effectual method of making known their grievances. Accordingly, since the new constitution was promulgated in 1817, we observe, by the public papers, that two attempts at insurrection have been made. But whether these have originated in the factious spirit of the nobles, or the discontents of the body of the people, has not been clearly explained. Yet though so little has been done for the people, the change has certainly been for their advantage. The administration of justice will no doubt be improved; the private wars and open rapine of the nobles restrained; and the powers taken from these persons, and conferred on the Commissioner, will be more beneficially exercised for the inhabitants at large. But a much more stable foundation would have been laid for good government, had the people been furnished with constitutional rights to protect themselves, even although they had not made a wise use of those rights in the first instance. (B.B.B.)

IRELAND.

The History of Ireland, down to the year 1789, is given in the article Ireland in the *Encyclopædia*, and its subsequent history will be found under Great Britain in this *Supplement*. In this article we shall confine our attention to the statistical and political state of the country.

Chap. I.—Statistics.

Divisions.—Face of the Country.—Soil.—Productions.—Climate.—Population.—Agriculture.—Manufactures.—Commerce.—Revenue.—Expenditure.—Debt.—Public Education and Charities.

Ireland is situated between 6° and 10° 40′ west longitude, and 51° 15′ and 55° 13′ north latitude. Its greatest length is 241 Irish, or 306 English miles; and its greatest breadth 137 Irish, or 174 English miles. In consequence, however, of the deep indentations of the shore on the west coast, there is not a spot in the kingdom 50 miles distant from the sea.

From the latest accounts, it appears that its superficial contents are 19,436,000 English acres, or 30,370 square miles. Mr Wakefield, however, makes it contain 32,201 square miles, or 20,437,974 English acres. (Beaufort, 14.) Mr Pinkerton assigns to it only 27,451 square miles (Pinkerton, i. 211); but it would rather appear that his estimate is below the truth. (Wakefield, i. 4.)

Divisions. This country is divided into four provinces, Ulster, Leinster, Connaught, Munster. Ulster, which is the most northerly province, contains 8375 square

Ireland. miles English, and comprises the following counties:

Counties.	Baronies.	Parishes.	Irish Acres.
Armagh, containing	5	20	181,450
Down,	8	60	348,550
Antrim,	8	77	387,200
Londonderry,	4	31	318,500
Donegal,	4	42	679,550
Tyrone,	4	35	463,700
Fermanagh,	8	18	283,450
Cavan,	7	30	301,000
Monaghan,	5	19	179,600
Total (Wakefield, I. 12. *et seq.*)	53	332	3,201,200

Leinster is the most easterly province, and adjoins the Irish Channel. It contains 7360 English square miles, which are divided into the following counties:

Counties.	Baronies.	Parishes.	Irish Acres
Louth,	4	61	110,750
Meath,	12	147	327,900
Dublin,	6	107	142,030
Wicklow,	6	58	311,600
Wexford,	8	142	342,900
Kilkenny,	9	117	300,350
Carlow,	5	50	137,050
Queen's County,	8	50	235,300
King's County,	11	52	282,200
Westmeath,	12	62	231,550
Longford,	6	23	134,150
Total of Leinster,	97	992	2,792,550

Connaught, the most westerly province of Ireland, comprises 7191 square miles English, and comprehends the following counties:

Counties.	Baronies.	Parishes.	Irish Acres.
Galway,	16	116	989,950
Mayo,	9	68	790,600
Sligo,	6	39	247,150
Leitrim,	5	17	255,950
Roscommon,	6	56	346,650
Total of Connaught,	42	296	2,630,300

Munster, the southern province of Ireland, contains 9276 English square miles, and is divided into the following counties:

Counties.	Baronies.	Parishes.	Irish Acres.
Cork,	16	269	1,048,800
Kerry,	8	83	647,650
Clare,	9	79	476,200
Limerick,	9	125	386,750
[illegible]erary,	10	186	554,950
[illegible]rford,	7	74	262,800
Total of Munster,	59	816	3,377,150

Ireland, therefore, contains in its four provinces,

Provinces.	Counties	Baronies.	Parishes	Irish Acres.
Ulster,	9	53	332	3,201,200
Leinster,	12	97	992	2,792,550
Connaught,	5	42	296	2,630,300
Munster,	6	59	816	3,377,150
Total,	32	231	2416	11,981,200

Face of the Country. The most elevated ground is to be found in the Bog of Allan. Its height above the Sea does not exceed 270 feet; yet, from this ridge, the waters of the rivers run to the different seas. This elevated ground is connected with the principal mountains of Ireland, diverging in the north from the hills of Tyrone, and leading in the south to those of Sleeve Bloom and the Galtees. The face of the country affords a pleasing variety of surface, consisting in some parts of rich and fertile plains, in others of little hills and acclivities, which succeed one another in frequent succession. Mountains. The chains of mountains are neither numerous nor considerable; the most remarkable are the Kerry Mountains, those of Wicklow, the Sleeve Bloom Chain between the King's and Queen's County, and the mountains of Mourne in the south of the province of Ulster. The following is a table of some of the most remarkable heights in the kingdom. (Wakefield, I. 10.)

	Feet above the Sea.
Macgillicuddy's Reeks, Killarney,	3695
Mangerton ditto,	2693
Stubh Donard, county Down,	2809
Nephin, Mayo,	2630
Crow	2660

Rivers. The numerous rivers and deeply indented bays of Ireland have given it greater facilities for internal navigation than almost any country in Europe. The Shannon is its largest stream, which rises in the northern part of Connaught, and after a course of 170 miles, during which it expands into six lakes, flows into the Atlantic Ocean between the counties of Clare and Kerry.—It is navigable by large vessels as far as Limerick.—The Bandon, another considerable river, rises in the mountains of Carberry, and running to the east, finally arrives at Kinsale, after many beautiful reaches of river scenery. The Lee rises in a lake to the west of Muskerry, and falls into the sea about 15 miles below Cork. The Blackwater rises in a bog near Castle Island, in the county of Kerry, and after a course of 60 miles, falls into the sea at Youghall. The Liffey rises about 10 miles to the south-west of Dublin, and after a winding course of 50 miles, falls into the bay of the same name. The Boyne rises in King's County, and after being joined by various streams, falls into the sea about two miles below Drogheda. The Sure rises at the foot of the Banduff Mountains, in the county of Tipperary, and falls into the sea at Waterford. The Barrow rises in King's County, and, uniting with the Sure, forms the right arm of Wa-

Ireland. terford Haven. The Slane rises in the county of Wicklow, and falls into a bay a little below the town of Wexford; and the Bann rises in the mountains of Down, and flows with impetuous force into the sea a little below Coleraine.

Lakes. The most considerable lakes of Ireland are Loch Neagh, Loch Earne, Loch Corrib, and the Lakes of Killarney. The first of these, Loch Neagh, is very extensive, covering 58,000 acres; but it exhibits no remarkable beauty in its shores, the adjacent country being, for the most part, flat, though well wooded. Many gentlemen's seats of great antiquity and beauty adorn its banks. Loch Earne, in the county of Fermanagh, consists, properly speaking, of two lakes, which unite in the vicinity of Inniskillen. The first, or uppermost, is 20, the second 15 miles long. Its greatest breadth is 12 miles. The banks of this lake, though sometimes rising to a considerable elevation, are rather distinguished by their amenity and softness, than by their sublime features. The adjacent country is covered with little knolls, or small hills, of 50 or 60 feet in height, which, being generally ornamented by wood, present a most agreeable appearance; and the numerous islands in the lakes themselves, amounting to 300 in number, are formed by the same prominences in the soil rising above the surface of the water. Loch Corrib, in the province of Connaught, is 20 miles long, but its medium breadth is only four miles.—Its banks exhibit nothing remarkable. The Lakes of Killarney form the glory of Irish scenery, and constitute one of the principal inducements to foreigners to visit that island.—They are three in number; the lower lake, consisting of 3000 acres, lies on the northern side of Macgillicuddy's Reeks; the middle lake, consisting of 640 acres, lies at the foot of Turk Mountain, and from thence the traveller is led by a winding stream of exquisite beauty to the upper lake, which covers 720 acres, and lies in the very centre of the Kerry Mountains. To those who have visited the Swiss and Italian lakes, it is hardly necessary to observe, that no scenery here at all approaches what they have met with there; but the Lakes of Killarney may well bear a comparison with the finest of the Scotch and English lakes. The range of Macgillicuddy's Reeks presents a splendid series of Alpine peaks, which form the back ground of almost all the scenery on the lakes; and the moist climate and mild winters of Ireland have given a verdure and richness to the arbutus and other shrubs which clothe the rocks and islands that rise out of the water, unlike any thing else in the British empire. Mucruss Abbey and Park form a most interesting addition to the lower lake, and the Island of Innisfallen, both from the luxuriance of the ivy with which it abounds, and the romantic forms of the aged trees with which it is shaded, excels any island that is to be met with in any lake in Europe.

Canals. The interior of Ireland is intersected by a variety of canals. The *Grand Canal*, which was originally begun by individuals, and subsequently completed after the Union by government, unites Dublin with Shannon harbour, while another branch proceeds to Athy, where it joins the Barrow. This canal intersects the Bog of Allan, and is of great service in supplying the capital with fuel. The *Royal Canal* begins at Glassmanogree, in the county of Dublin, and extends to Coolnahay, beyond Mullinghar. It is of great service in the carriage of loam and turf. The *Newry Canal* runs along the Southern boundary of the county of Down; it is cut from Carlingford Bay, and joining the Newry water, embraces the upper Banco at Porto Down. In this way the navigation is continued to Loch Neagh, while a branch leads off to the Tyrone collieries. This canal admits vessels of sixty tons burden, and is one of the most useful in the kingdom. Generally speaking, however, the attempts which have been made to improve the internal navigation of Ireland have met with very bad success, and many companies, as well as individuals, have been ruined in the attempt;—a fact which demonstrates that, to effect such undertakings, the interposition of government is, in the present circumstances of the country, indispensable. (Wakefield, I. 651; Young, II. 66.) The Grand and Royal Canals have cost L.2,000,000 Sterling; and the only one which now yields a profitable return is the Newry Canal. *(Ibid.)* These facts lead to a suspicion, either that money laid out in such undertakings is misspent, until the state of the country leads to a much greater consumption of bulky articles, or that the vicinity of every part of the island to the sea, or some of its deep indentions, renders such undertakings less advantageous here than in other countries. This matter is well worthy of deliberate consideration, in determining upon the policy of continuing any farther grants of the public money to the improvement of the country in this particular. (Wakefield, I. 650.)

Harbours and Havens. The harbours of Ireland are among its most remarkable natural advantages. Fourteen harbours for ships of the line, seventeen for frigates, and thirty-six for coasting vessels, besides twenty good roads, are to be found on the different coasts of the island. Bantry Bay is one of the most secure and capacious harbours in the world, being nine leagues long and two broad, surrounded by lofty rocky shores. In the middle of the haven is Bear Island, six miles long; and between it and the northern shore is Bear Haven, fit for the largest fleets. The Cove of Cork is celebrated in the naval world for the extent and depth of its water. The entrance is about a mile in breadth, after passing which the sea expands into a fine basin, capable of containing the whole navy of England. In the centre are three islands, which break the force of the sea, and serve as a shelter to the shipping. Crookhaven, in the county of Cork, is also an admirable harbour, landlocked on every side, with a spacious bay, an easy outlet, and good anchorage in three fathoms at low water. Dingle Harbour, on the west coast, is a most eligible shelter for shipping, six leagues in length, and four in breadth, sheltered from all winds, and with 30 feet water. In Lough Carlingford is to be found a large anchorage, with depth of water sufficient for the largest ships; but, unfortunately, several dangerous rocks obstruct the entrance to the harbour. Belfast Loch, also, is of great utility in a commercial

point of view; and, on the west coast of the island, Galway Bay, Butterby Bay, Conichin Bay, and Sligo Bay, all afford most remarkable facilities for commerce. Lough Swilly, in the county of Donnegal, is one of the noblest natural harbours in Europe, twenty miles long and two broad, with good anchorage, and deep water, fit for the reception of the largest fleets. Lough Foyle is a large haven, with twelve fathom water, and capable of affording shelter to vessels of any description. Besides these, the island possesses a vast number of other natural harbours, which would be eagerly improved in other countries, less bountifully supplied by nature.

Giant's Causeway. The *Giant's Causeway* is one of the greatest natural curiosities of Ireland. It is situated on the north-eastern extremity of the island, where the coast rises to the height of 700 or 800 feet above the sea. The cliffs there are upwards of 400 feet in height; and at their feet lies the causeway, composed of the summits of basaltic columns, so nicely wedged, as to form a solid impervious mass of natural masonry, with an irregular and broken surface. This extraordinary pavement extends for above a mile along the coast. The sublime features of this spot rival its geological interest; and in no part of the empire is a nobler cliff to be seen than is presented by Cape Pleskin, which overhangs the ocean with a precipice 374 feet in height. Adjoining to this natural curiosity is Fairhead, the north-east promontory of Ireland, and elevated above 500 feet above the sea. It presents a vast mass of rude columnary stones, many of them exceeding 200 feet in length; and at the feet of these gigantic columns lies a wild waste of natural ruins, of an enormous size, which, in the course of ages, have been tumbled down from their foundations by storms, or other convulsions of nature. A savage wildness characterises this great promontory, at the foot of which the ocean rages with uncommon fury.

The Atlantic Ocean breaks with inconceivable violence upon the western shores of Ireland; and, to this cause, the extraordinary indented line of the coast is to be attributed. Along the greater part of this coast, the sea appears to be gaining on the land; and, in many places, particularly in the peninsula of Rossgall, in the county of Donnegal, large tracts have been overwhelmed by sand. (Hamilton's *Memoir*, Vol. VI. *Irish Trans.*)

Soil. The *soil* of Ireland is, generally speaking, a fertile loam, with a rocky substratum; although there are many exceptions to this description, and many varieties. Generally speaking, it is rather shallow; to which cause the frequent appearance of rocks near the surface, or at no considerable depth, is to be attributed. It possesses a much greater proportion of fertile land, in proportion to its extent, than either England or Scotland, as will be seen from the following table. (*Parliamentary Reports*, 1813-14.)

	English Acres.
Total extent of surface,	20,437,974
Total extent of bog and mountain,	2,330,000
Remain of arable ground,	18,107,974

Not only is the island blessed with this extent of arable ground, but it is almost all of such a quality as to yield luxuriant crops, with little or no cultivation. Sand does not exist except on the sea-shore. Tenacious clay is unknown, at least near the surface. Great part of the land of Ireland throws up a luxuriant herbage, without any depth of soil, or any skill on the part of the husbandman. The county of Meath, in particular, is distinguished by the richness and fertility of its soil; and, in Limerick and Tipperary, there is a dark friable sandy loam, which, if preserved in a clean state, will yield crops of corn several years in succession. It is equally well adapted for grazing as for arable crops, and seldom experiences either a winter too wet, or a summer too dry. The vales, in many of the bleakest parts of the kingdom, as Donnegal and Tyrone, are remarkable for their richness of soil and luxuriance of vegetation, which may be often accounted for by the deposition of the calcareous soil, washed down by the rains of winter, which spreads the richest manure over the soil below, without subjecting the farmer to any labour. (Wakefield, I. 79, 80.)

Bogs. The *bogs*, or peat mosses, of Ireland, form a remarkable feature of the country, and have been proved by the Parliamentary Commissioners to be of great extent. They estimate the whole bogs of the kingdom at . 2,330,000 Acres Eng.

Of these are flat red bog,	1,576,000
Mountain,	1,255,000

These bogs, for the most part, lie together. In form, they resemble a great broad belt, drawn across the centre of Ireland, with its narrowest end nearest to the capital, and gradually extending in breadth as it approaches the Western Ocean. The Bog of Allan is not one contiguous morass, but this name is indiscriminately applied to a great number of bogs, detached from each other, and often divided by ridges of dry country. These bogs are not, in general, level, but most commonly of an uneven surface, swelling into hills, and divided by vallies, which affords the greatest facility to their being drained and improved. In many places, particularly in the district of Allan, the rivulets which these inequalities of surface produce have worn their channels through the substance of the bog down to the clay or limestone gravel beneath; dividing the bog into distinct masses, and presenting, in themselves, the most proper situations for the main drains, and which, with the assistance of art, may be rendered effectual for that purpose. (*Fourth Report of the Parliamentary Commissioners*, 1813-14.)

The two circumstances which the Commissioners point out, as affording the principal inducements to attempt the improvement of the Irish bogs, are the elevation at which they are all placed above the sea, and the uneven surface which they almost uniformly exhibit. The following table will show, in one view, the elevation above the sea of the principal bogs to which their attention has been directed:

Ireland.

	Highest Point.	Lowest.	Greatest Depth.	Least.
Lullymere Bog, ...	256	214		
Timahoe Bog, ...	289	232		
Bog of Mounds, . . .	296	254		
Clare Bog, . . .	298	255		
Bogs on west of Shannon,	76	29	43	21
Bogs of Longford and Leitrim,	114	30	43	30 aver.
District of Boyne Bogs, .	336	218	40	22
Westward of Brusna, . .	274	114	44	30
Southward of do. . .	310	111	45	22
Districts of Inny and Loughree, . . .	253	176	47	30

From these data, the practicability of draining the bogs of Ireland is very obvious; and, as far as the estimate of the engineers can be depended on, the expence will be amply repaid by the quantity of useful land recovered. The estimate for draining the eastern district of the Bog of Allan is L.147,052, and the quantity of land which would be gained is 36,430 English acres; the outlay upon which would be more than covered by the first year's produce.

Woods.

Like all other countries of Europe, this island was formerly clothed with extensive forests, which are now no longer to be met with. Fermanagh is better clothed with timber than any other county in the kingdom; and oak abounds upon the mountains of Killarney, and in the glens of Wicklow. One remarkable feature of the country, however, strongly indicative of the effects of a non-resident body of landed proprietors, is, that new plantations are hardly ever to be met with. In the county of Clare, there are only 780 acres of plantation, and in Kilkenny 1800; quantities much inferior to what many Scotch proprietors possess on their own estates. (Wakefield, I. 561.) A traveller may go from the Giant's Causeway to Killarney, and from Cork to Londonderry, without meeting as many young woods as their are counties on his road.

Minerals.

This island rests for the most part on a bed of granite. It abounds in the neighbourhood of Dublin, and in some parts of the county of Kilkenny. It is also found emerging from beneath the basalt of Sleeve Gallen in the county of Derry.

Limestone.

Limestone is met with in great abundance in various parts of Ireland; indeed, in all the counties except Wexford, Wicklow, Tyrone, and Antrim. The rivers Barrow, Lee, Bride, Kenmare, and Blackwater, form the boundary of the limestone districts in their respective counties. The varieties of this mineral, which are found in Kilkenny and in the county of Derry are susceptible of a very high polish, and hence well adapted for the purposes of building and ornamental architecture. In the Cave of Dunmore, in the former county, alabaster is found in large quantities. The basalt district of country is very extensive, reaching from the estuary of Carrickfergus to Loch Foyle, and extending inland to the northern shore of Loch Neagh. It rises to a great height at the north-western extremity of the island, forming the lofty headlands of Pleskin, Fairhead, and Bengore, already noticed.

Coal.

Coal is met with in various parts of the island. In Ulster there are two coal mines worked, one in Antrim at Ballywater, and the other near Dungannon in Tyrone. Coaleries are wrought near Arigna, in the county of Leitrim. The province of Leinster is abundantly supplied with this mineral. The coalery which is worked near Castle Coomer, at Doonane, in Queen's County, produces annually 40,000 tons. It costs 10s. a-ton to extract it, and gives employment to 600 persons. At Kilkenny also coal is worked. A continuation of the Castle Coomer coal is wrought in Tipperary; and in the barony of Duhallow, and the county of Cork, it has been discovered. With this exception, however, the southern parts of the island are destitute of this valuable mineral.

Gold and other Metals.

Pieces of native gold have been discovered in the bed of a stream flowing down from Crowbane, in the county of Wicklow; but it does not bear the expence of working. Silver was formerly extracted to a considerable extent from the lead mines in Antrim, Sligo, and Tipperary, but the works were destroyed in the insurrection in the time of Charles I. Copper is found at Ross Island in Killarney, at Mucruss, Crowbase, and Ballymustaglo, in the county of Wicklow, and in some parts of the counties of Cork, Meath, Waterford, and Dublin; but at present no mine of this mineral is wrought in the island. Lead is found at Enniscorthen in Wexford; near Glendallogh, in Wicklow; and in the county of Donnegal, but not above one or two of these various mines are wrought. The most valuable of these metals, iron, is very plentiful in various parts of the island, and, in the seventeenth century, it was wrought to a great extent; but at present they are neglected. Grey ore of manganese has been found in the peninsula of Howth, and in various parts of Kilkenny, Mayo, and other counties. Fragments of tin-stone occur in the gold mine of Wicklow; and porcelain earth, equal to the finest in Cornwall, has been found in the same county.

Climate.

The climate of Ireland is considerably more mild than that of England, and the southern and western part of the island greatly more so than the northern. The difference in this respect, indeed, is greater than can be explained by the difference of latitude, and is probably owing to the immediate vicinity of the Western Ocean. On the mountains of Kerry, and in Bantry Bay, the arbutus and some other shrubs grow in great luxuriance, which are not to be met with again till the traveller reaches the south of the Alps. The snow in these parts of the island seldom lies for any time, and frost hardly ever continues beyond a few days, and while it lasts it is by no means intense. The mildness and humidity of the atmosphere produce a luxuriance and rapidity of growth in vegetation, to which no other part of the empire can afford any parallel; and this appears in the most remarkable manner in the ivy and other evergreens, with which the kingdom abounds. These are not

Ireland.

only much more plentiful, but far more luxuriant, and of much quicker growth, than in the most favoured parts of Great Britain. To those who are accustomed to the dry weather of this island, the continued rains of the south and west of Ireland are extremely disagreeable; but it is to this peculiarity in their climate, that the Irish have to attribute the richness of their pasturage, an advantage which, coupled with the remarkable dryness and friability of the soil, points, in an unequivocal manner, to a rotation of crops, in which grazing should occupy a principal place.

The following table exhibits the mean temperature of different places in Ireland, in the interior and on the sea coast, taken from very accurate observations. (Wakefield, I. 193, 199, 206, 218.)

	Latitude	Mean Temp.
Mean temperature of north coast, near Bally-castle,	55° 12′	48° 0′
Do. of Ennisor, west coast,	54 48	46 6
Do. of the vicinity of Dublin,	53 20	49 4
Do. of coast of Cork,	5[illegible] 54	51 2
Do. of neighbourhood of Londonderry, 100 feet above the sea,	53 0	46 9
Do. near Armagh, 58 feet above the sea,	54 20	47 5
Do. of neighbourhood of Tullamore, 206 feet above the sea,	53 12	48 0
Do. of the city of Londonderry,	55 0	47 6 to 49°
Do. of Dublin,	53 21	50 0 to 52
Do. of Cork,	51 54	52 5 to 53

It would appear that the climate of Ireland has for some years past undergone a progressive alteration for the better. (*Ibid* I. 214.) The following table exhibits the changes in this respect, which have taken place within the last twenty years:

State of the Thermometer at Dublin and Belfast, from 1792 *to* 1804.

DUBLIN.

Years.	Greatest.	Least.	Mean.
1792,	77° 0′	19° 5′	50.509
1793,	75 5	28	49.64
1794,	79 50	32	51.915
1795,	78	19 50	49.191
1796,	78 5	20	48.847
1797,	75	22	49.49
1798,	81	25	49.22
1799,	74	14 50	45.06
1800,	81 50	23	47.809
1801,	75	24	49.278
1802,	76	22	48.697
1803,	79 50	22	49.16
1804,	75	31	49.916

BELFAST.

Years.	Greatest.	Least.	Mean.
1796,	68° 50′	30° 0′	52.78
1797,	68	28	53.83
1798,	70	33	51.05
1799,	68 25	31	51.13
1800,	73	33 5	52.29
1801,	79	35	55.44
1802,	73	23	52.90
1803,	77 20	25	52.60
1804,	73	31 60	55.55
1805,	72 52	32 50	53.01
1806,	73	32 50	53.76
1807,	75	28	51.91
1808,	75 60	27	52.80
1809,	78	30 3	55.20

The following table shows the Quantity of Rain which fell in a period of eighteen years, at Dublin; Rains.

	Inches.	Days of Rain.	Years	Inche	Days of Rain.
1792	30.700	288	1802	27.97	222
1793	22.855	214	1803	19.67	193
1794	28.82	222	1804	30.03	231
1795	26.48	196	1805	22.47	
1796	21.94	204	1806	24.49	
1797	24.45	216	1807	26.50	
798	20.16	191	1808	23.182	
1799	22	126	1809	28.899	
1800	23.56	197	1810	23.663	
1801	21.96	194			

At Londonderry;

Years.	Inches.
1795	32.861
1796	25.718
1797	30.821
1798	33.231
1799	34.770
1800	29.226
1801	32.197
Average,	31.118

At Cork.

Years	Inches.	Years	Inches.
1738	54.5	1744	33.6
1739	54.5	1745	48.4
1740	21.5	1746	30.0
1741	33.6	1747	30.0
1742	38.1	1748	37.4
1743	39.3		

At Cork, and generally over the south of Ireland, it appears that the winds blow three-fourths of the year from the west and south-west. (Smilles's *Survey of Cork.*)

An account of the actual population of Ireland, drawn from a survey by Government, is a great desideratum in the statistics of the country. The following table will show with what rapidity the numbers of the people have increased within the last 50 years. (Wakefield, II. 712.) Population.

	Souls.
In 1754 Ireland contained	2,372,634.
1767	2,544,276.
1785	2,845,932.
1791	4,206,612.

Ireland.

Ireland.

Since that period a very great increase has unquestionably taken place. The present population does not probably fall much short of 5,500,000 (Newenham, 41.)

Without pretending to any accuracy of detail, the following may be considered as an approximation to the population of its principal cities, according to the most authentic accounts which can be collected. (Wakefield, II. 712-20.)

1.	Dublin,	167,899.
2.	Cork,	90,000.
3.	Limerick,	60,000.
4.	Waterford,	40,000.
5.	Belfast,	2[illegible],095.
6.	Drogheda,	15,000.
7.	Kilkenny,	14,975.
8.	Londonderry,	13,635.
9.	Kinsale,	8150.
10	Wexford,	5922.
11.	Colerain,	5000.
12	Lisburn,	5000.

Freeholders.

The number of *freeholders* in Ireland is very great. They are, for the most part, tenants of the landed proprietors, possessing a life interest in their little farm, so as to entitle them to vote at elections. The following table* of the number of freeholders, most of whom are not worth L.10, will be not a little surprising to the English reader:

Counties.	40s.	L.20.	L.50.*
Antrim,	8074	152	227
Armagh,	6053	120	144
Carlow,	3249	295	359
Cavan,	5720	177	184
Clare,	9290	508	378
Cork,	4605	1266	1733
—— City,	508	420	215
Donnegal,	6131	128	122
Down,	14,613	225	442
Drogheda Town,	188	29	10
Dublin,	1007	229	974
—— City,	12	130	470
Fermanagh,	6869	301	232
Galway,	12,782	224	277
Kerry,	8970	336	480
Kildare,	1713	164	545
Kilkenny,	1624	226	406
—— City,	27	45	33
King's County,	2557	288	235
Leitrim,	6035	211	102
Limerick,	5912	891	986
—— City,	429	237	206
Londonderry,	9902	194	278
Longford,	2118	114	117
Louth,	756	56	71
Mayo,	15,443	204	193
Meath,	15[illegible]	69	537
Monaghan,	5521	146	162
Queen's County,	4169	437	847
Roscommon,	5477	129	435
Sligo,	2007	114	75
Tipperary,	18,896	1602	2270
Tyrone,	9854	281	147
Waterford,	2646	312	527
West Meath,	[illegible]449	131	421
Wexford,	5878	509	265
Wicklow,	1661	163	84

AGRICULTURE.

The Agriculture of Ireland is, generally speaking, in a very backward state. With a few exceptions, such as the county of Meath, and some other well cultivated districts, the farmers are destitute of capital, and labour small crofts, which they hold of middlemen interposed between them and the landlord. The fact that the landlord never, in Ireland, lays out any thing upon repairs or buildings, coupled with the general inability of the farmer to do either in a substantial manner, is very significant as to the state of agriculture. (Tighe's *Survey of Kilkenny*, 412; Wakefield, I. 244.) The leases are generally of long endurance; three lives or 31 years is a common rate. But the worst features of the rural economy of this island are the entire want of capital in the farmers, and the complete indifference of the landlord to the character, wealth, or industry, of his tenant. "Capital," says Mr Wakefield, "is considered of so little importance in Ireland, that advertisements constantly appear in the newspapers, in which it is stated, that the preference will certainly be given to the highest bidder. Bargains are constantly made with a beggar, as a new tenant, if he offers more rent, invariably turns out the old one, however industrious. Even if the unfortunate wretch has a little ready cash to begin with, it only serves, in 99 cases out of 100, as a temptation to the landlord, who, when the fact becomes known to him, finds means to obtain it under the name of a fine for possession." (Vol. I. p. 587.) Regard to present gain, without the least attention to the future, constitutes the principal object of the Irish landlord. (*Ibid.* I. 304.)

Rent.

The rent of land in Ireland from these causes, coupled with the excessive competition of the peasantry for small farms, as their only means of subsistence, has risen to a great height. (Townsend's *Cork*, 218; Wakefield, I. 582.)

The following table exhibits the average rent in the different counties, as they were taken by Mr Wakefield in 1810, distinguishing the rent for cultivated area from that of the total area:

* This table shows an aggregate of 184,492 freeholders voting on freeholds of 40s. value.

Ireland.

	Green or Cultivated Acres.			Total Area.		
	L.	s.	d.	L.	s.	d.
Antrim,	0	7	6			
Armagh,	1	6	0			
Carlow,	2	9	6			
Cavan,	1	6	0			
Clare,	1	17	0			
Cork,				1	5	0
Donnegal,				0	7	0
Down,	2	0	0			
Dublin,				3	0	0
Fermanagh,	1	5	0			
Galway,	1	10	0			
Kerry,				0	10	0
Kildare,				1	8	0
Kilkenny,				2	0	0
King's County,	1	15	0			
Louth,				1	10	0
Leitrim,				0	13	0
Limerick,	3	8	3			
Longford,	1	7	6			
Londonderry,				0	18	0
Mayo,	1	5	0			
Meath,	2	10	0			
Monaghan,	1	6	0			
Roscommon,				1	15	0
Queen's County,	2	0	0			
Tipperary,	3	0	0			
Tyrone,	2	0	0	1	6	0
Waterford,	2	0	0			
West Meath,	2	0	0			
Wexford,				1	8	0
Wicklow,				0	12	0
Average,	L.1	18	8	L.1	4	9

And calculating the difference between the green acres and total area at one-fourth (according to Mr Arrowsmith's opinion), this will give L.1, 7s. 1d. as the average rent of the total area of the island. This, upon 12,722,615 Irish acres, gives L.17,228,540, as the total rental of the island, in Irish money (Wakefield, I. 805); or, upon 20,437,974 English acres, yields an average of about 17s. *per* English acre.

The capital laid out in the improvement of the soil is extremely small when compared with that employed in the neighbouring kingdoms of England and Scotland. In 1799, Mr Young calculated that, converting Irish acres into English, it would require an outlay of L.5 an acre to place Ireland on a footing with England in this respect. The whole amount, therefore, of the sum required would be L.88,341,136. (Young's *Irish Tour*, II. 9.) From the change in the value of money, Mr Wakefield has since calculated that the sum required to effect such a change would be L.120,000,000, independently altogether of the capital which the British agriculturist brings to his farm in order to carry on the cultivation of the land. When it is considered how little capital is thus sunk in the Irish soil, and recollected that the average rent of England is only 20s. an acre, even under the superior mode of cultivation which is there pursued, it is obvious how much the proportion of the produce of the soil in Ireland, which goes to the landlord, has encroached on what should be left as a remuneration to the farmer. (Wakefield, I. 585.)

Price of Land.

The price of land varies in different parts of Ireland. In the neighbourhood of Belfast, and thence to Armagh, it brings thirty years' purchase; in the greatest part of the island, it does not exceed twenty, and, in the richest districts, it may often be bought for sixteen or eighteen. The exposure of landed estates to public sale takes place very seldom, which is perhaps one cause of their not bringing so high a price as they would otherwise do. (*Ibid.* I. 307.)

Agricultural Districts.

The whole country is classed by Mr Wakefield into nine agricultural divisions, in each of which the mode of culture is somewhat different from what it is in the others. The first district comprehends the flat parts of Antrim; the eastern side of Tyrone, Down, Armagh, Monaghan, and Cavan. Throughout this district, the farms are extremely small, and the land is generally dug with the spade. Potatoes, flax, and oats, are the crops usually cultivated, and these are grown till the land is exhausted, and suffered to "lie at rest," as they term it, till its strength is recruited by the cow, the goat, two or three sheep, and the poultry lying upon it, for some years. The ploughs used in this district are of the rudest structure, and perform their work in the most slovenly manner. Three or four neighbours unite their strength to each plough, every one bringing his horse, his bullock, or his cow. All the other operations of agriculture are performed in an equally slovenly manner. The little wheat that is raised is "lashed," as they call it, that is, the grain is knocked out by striking the sheaf across a beam placed above a cloth, which, however, is afterwards thrashed with a flail. This operation of thrashing usually takes place in the highway, and it is dressed by letting it fall from a kind of sieve which, during a pretty strong wind, is held breast high by a woman. Many cottars in this district have a cabin with no land attached to it. They hire an acre or two, for grass or potatoe land, from some cottar in their vicinity. The custom of hiring labourers is unknown, the neighbours all assisting each other in their more considerable occupations, such as sowing, reaping. The dwellings here are miserably small; often too small to contain the numerous families that issue from their doors. Land is everywhere divided into the most minute portions. (Wakefield, I. 363; Dubourdieu's *Down*, 39.)

Under the second district may be comprised the northern part of Antrim, Londonderry, the north and west of Tyrone, and the whole of Donnegal. Agriculture here is in a worse state than in the preceding district. There is no clover, and hardly any wheat. Clover is unknown, and the only mill for the preparation of grain is in Derry. (*Ibid.* I. 372.)

The third district comprehends the northern parts of Fermanagh. Here the farms are much larger than in the former, and the agricultural system pursued far superior. They plant potatoes on

a lea, twice reversing the lands, and the course is flax, oats, and weeds. Some wheat is grown, but oats is still the prevalent crop. In the neighbourhood of Enniskillen, the farmers are so rich as to be able to eat butcher meat daily and drink wine. (Wakefield, I. 379.)

The fourth district comprehends Sligo, Mayo, Galway, Clare, and parts of Roscommon, and Longford. In some parts of this district the spade culture is pursued; but, in general, the land is cultivated by a plough drawn by four horses abreast. In Roscommon, the old custom of yoking the horses by the tail is still continued, although, so early as 1634, an act of Parliament was passed against this absurd practice. (*Life of the Duke of Ormond*, I. 79.) Oats are chiefly raised in this district, and, along the coast, barley is cultivated. A large portion of the rent depends on the illegal distilleries, and much of the district is let on lease to several persons jointly, according to the village system. (Wakefield, I. 381.)

In the fifth district, which comprehends Limerick, Kerry, the south side and northern part of Cork, and the county of Waterford, cultivation is in a very rude state; little corn is grown here, with the exception of the southern part of Cork. Land is extremely divided, and the farms very small. The greater part is a grazing country. (*Ibid.* I. 387.)

The sixth district includes the southern parts of Cork. The spade culture is here almost universal, and the farms unusually small. Hogs constitute the main support of the poor. (Townsend's *Cork*, 194.)

The seventh district includes part of Tipperary, with Queen's County and King's County. The best farming in Ireland is observable in this district; a systematic course of husbandry being pursued, by which the land is kept in good heart. Oxen and horses are used in the plough, and hedge-rows and good wheat fallows are to be seen. Near Roscria the cultivation of turnips is followed, and they succeed well. Ninety acres is considered a large farm. Leases are generally for three lives. (Wakefield, I. 398.)

The eighth district comprises Wexford and a part of Wicklow. Beans are here sometimes introduced into cultivation, but they are sown broad-cast, and never hoed. The mode of ploughing is very awkward; one man holds the plough, another leads the horse, and a third sits on it to keep it down. Notwithstanding this rude culture, however, the rents are enormous. (*Ibid.* I. 407.)

The ninth district comprehends the northern part of Kilkenny, Kildare, the cultivated parts of West Meath, Meath, and Lowth. Wheat here enters into the system of culture, but the preparatory fallows are very bad. Clover has been introduced into the district, but under the bad system of sowing it upon land exhausted, and covered by weeds. Farms are large, and the mode of culture similar to what is pursued in England, though the details are executed in a much more slovenly manner. (*Ibid.* I. 413.)

The following table exhibits, at one view, the produce of these different districts, according to the mode of cultivation at present adopted. The seed and produce is given in pounds Avoirdupois:

DISTRICTS.	WHEAT.		BEAR.		BARLEY.		OATS.		POTATOES.		FLAX.	
	Seed.	Prod.	Seed.	Prod.	Seed.	Prod.	Seed.	Prod.	Seed.	Prod.	Seed.	Prod.
1	224	2271	203	3500	209	2982	333	2636	2392	22.248	30	785
2	175	2135			203	2646	291	3227	1383	15.183		
3												
4	222	2024	196	3584	244	2765	308	2749	2144	22.289		
5	243	2537	261	4480	249	3024	298	2970	2592	24.328		972
6												
7	232	1857	187	3131	173	2828	320	2265	2660	22.358		
8	186	2353			296	2614	368	2606	2632	21.140		896
9	257	2353	211	3494	246	3235	361	3063	2639	27.113		824
Average in Winchester bush. to Irish acres,	3.38	33.6	4.01	69.2	4.4	54.6	8.4	72.4				
To English acres,	2.086	20.74	2.47	24.7	2.71	33.7	5.18	44.5				

General Observations on the Husbandry.

The implements of husbandry used in Ireland are all of the rudest construction. The plough, the spade, the flail, the carr, all equally partake of imperfections and defects. The fallows are not well attended to; three ploughings are usually deemed sufficient, and, from the imperfection of the plough, the ground at the end is generally full of weeds. Trenching land is very general; they form it into beds, and shovel out a deep trench between them, throwing up the earth. The expense of this operation is about 8s. an acre. Wheat, as will be seen from the preceding details, is not by any means generally cultivated. It is unknown in Monaghan, Tyrone, Derry, Donnegal, Sligo, Mayo, Leitrim, and Cavan, though it is grown to a considerable extent in Kilkenny, Carlow, Dublin, Meath, Louth, and parts of Limerick, Tipperary, Clare, and Cork. It is generally sown after potatoes or fallow. The Irish wheat is, for the most part, coarse and of inferior quality, and does not yield so much saccha-

Ireland.

rine matter by 20 *per cent.* as the English. (Wakefield, I. 429, 442.)

Barley is more generally cultivated than wheat, and it is generally sown after potatoes. Oats, however, constitute the species of grain most extensively raised; it is calculated, that throughout the whole kingdom, there are ten acres of oats sown for one of any other species of corn. The Irish oats, however, are decidedly inferior to the English. The potatoes of Ireland have long been celebrated, both on account of their quantity and excellent qualities. They are cultivated on every species of soil, either in drills or lazy beds. Potatoe land lets from L.6, 6s. to L.10, 10s. *per* acre; and the expence of culture, including rent, varies from L.13 to L.16 *per* acre. The produce is from 800 stone to 1000 stone the acre, at twenty-one pounds to the stone; that is, from 16,800 to 21,000 pounds. (*Ibid.* I. 450.)

The indigenous grasses of Ireland are not of any peculiar excellence. Notwithstanding all that has been said of the fiorin grass, its excellence and utility may be called in question. Their hay is seldom from seed, generally consisting of the spontaneous produce of the soil. Clover is almost unknown. Mr Newenham calculates that there are not 5000 acres under this crop in the whole island. (Newenham, 314; Wakefield, I. 467.) There are few living hedges in Ireland; in the level stone districts, stone walls, and, in other places, turf-banks are the usual fences.

The dairy is the most extensive and the best managed part of Irish husbandry. Kerry, Cork, Waterford, Carlow, Meath, West Meath, Longford, and Fermanagh, as well as the mountains of Leitrim and Sligo, are principally occupied by dairy farms. Butter is the chief produce. The average number of cows on a dairy farm is thirty or forty; three acres of land, of middling quality, are deemed necessary for the subsistence of each cow. The average produce of a cow is eight quarts in twenty-four hours in summer, and five in winter; four good milkers will yield half a *cwt.* of butter in a week. The best butter is made in Carlow; the worst in Limerick and Meath. Generally speaking, the Irish are very clean in making this article, and it is exported to England, the East and West Indies, and Portugal. (Wakefield, I. 325, *et seq.*) The grazing of Ireland is not, as in England, a part of the regular rotation of crops, but is carried on in a country exclusively devoted to the breeding of cattle like the Highlands of Scotland. Great tracts of the country also are devoted to the grazing of sheep. Roscommon, Galway, Clare, Limerick, and Tipperary, are the chief breeding counties for sheep; and Galway, Clare, Roscommon, Tipperary, and Meath, are the places where they are fattened. The sheep are of the long-woolled kind, and very large; they are never kept in sheep-folds, and hardly ever fed on turnips; which is chiefly owing to the very limited demand for mutton among the labouring people. (*Ibid.* I. 341.)

Agricultural Exports.

The *Agricultural Exports* of Ireland have increased at a very rapid rate within the last forty years, owing chiefly to the great demand and near vicinity of England.—We have given a view of the Irish exports of oats and oatmeal, wheat and wheat flour, and of all other kinds of grain, in the tables contained in our article on the CORN LAWS AND TRADE, particularly table eleventh, to which we beg to refer the reader.

Butter.

The export of butter to England and Scotland has, of late years, been very great.

Year ending	England. Cwts.	Scotland. Cwts.	Total.
5th January 1814,	335,761	16,071	351,832
. 1815,	334,856	16,819	351,675
. 1816,	316,209	21,169	337,378
. 1817,	286,678	17,286	303,964

To foreign parts, in 1814,	109,682
. . 1815,	80,479
. . 1816,	90,815
. . 1817,	87,154

Of these, upwards of 50,000 cwts. were annually exported to Portugal.

Beef and Pork.

The export of beef and pork has increased in the same striking manner.

Exports of Beef, on an average of five years, ending		Barrels.	Bullocks. and Cows.
	1782,	172,690	2,993
. . . .	1790,	138,[illegible]16	
. . . .	1795,	128,598	
Of eight years, ending	1796,	123,877	17,258
. 5th March	1803,	112,059	25,494
. . . Year	1804,	79,347	28,522

Pork Exported from Ireland.

		Pork, Barrels.	Bacon, Flitches.	Hams, Cwt.	Hogs.
On an average of Seven years, ending	1770	41,649	7,881		233
——————	1777	55,240	19,125		624
Five years, ending .	1782	87,085	5,985	317	280
Seven years, ending	1792	94,079	41,418	945	
Year .	1796	114,844	70,144		
Year 1802 to Jan. 5	1803	117,676	90,772		
Year .	1804	119,049	114,382	3955	12,976

To these tables we shall subjoin a statement of the agricultural exports of Ireland to Great Britain, during the year 1819, which shows equally its progressive increase and the invaluable importance of the British market to Irish industry.

Exports of Ireland to Great Britain during the year 1819.

Oats,	Quarters, .	759,608
Wheat,	do. . .	127,308
Barley,	do. . .	20,290
Beans,	quarters, . .	3,908

Ireland.

Oatmeal,	cwts.	47,150
Flour,	do.	92,898
Cows and oxen,	number,	46,330
Hides,	do.	10,710
Sheep,	do.	14,498
Lamb skins,	do.	269,204
Calf ditto,	do.	70,218
Lime,	tons,	8,183
Swine,	number,	49,212
Bacon and hams,	cwts.	234,338
Salted beef,	barrels,	59,807
Butter,	cwts.	429,614
Bones,	tons,	917

Manufactures.

Linen Manufacture.

The manufactures of Ireland are now very considerable, particularly the linen manufacture. This great and staple branch of Irish industry was established by the Duke of Ormond, in 1669; and, in the beginning of the following century, Parliament took it under its protection, and voted considerable sums of money for its support. At the same period, a Board was established, which has since exerted itself most vigorously for its encouragement. It enhances the value of this manufacture to the Irish population, that the raw material of which it is composed is raised almost entirely within the island. It would appear that the number of acres under flax in 1810 was little short of 100,000, which, at 30 stone an acre, and 10s. 6d. the stone, will give an annual produce of the raw material worth L.1,500,000. (Wakefield, I. 683.)

Spinning by the hand was universal till the commencement of the present century; and, though the use of machinery has since been introduced, yet it is by no means invariably followed, in consequence of the very low rate of wages at which the manufacturers can get spinning performed by the wives and daughters of the labouring population. The Irish women have long been celebrated for their skill in this department. The earnings of the weavers depend on their industry, and the fineness of the materials on which they work. The average earnings of a linen weaver may be estimated at 7s. a-week. Their looms cost from four to five guineas, but many houses will hold three looms. The weavers estimate that, when working themselves, they can make a web a-week, and a web is, at an average, worth 10s.

The principal seat of the linen manufacture is in Ulster; but, with the exception of Wexford and Wicklow, where it is unknown, it flourishes all over Ireland. In the neighbourhood of Belfast, at Leitrim, at Londonderry, in Donnegal and Tyrone, in Cavan, Louth, Meath, and Dublin, it flourishes in a remarkable degree. The quantity sold in Dublin, during the year ending March 1, 1809, appears from the following statement. (*Reports of Linen Board*, VI.; *App.* 18.)

Average value of 10,227 boxes inwards bound,	L.1,636,320
Ditto outwards bound, 9279 boxes,	1,738,590
Total,	L.3,374,910

Ireland.

	Inwards.	Outwards.
The linen entered at the Linen Hall, in the year ending 1st March 1808, was, in boxes,	9,495	9,060
Ditto 1809,	10,277	9,279
Increase,	782	219

The pieces of linen bleached in the county of Londonderry may amount to 250,000; and estimating the value of each piece at L.2, 5s. 8d., the actual value of the linen bleached in this county alone may be estimated at L.562,500. On the river Bann there are twenty bleachfields, which bleach annually, at an average, 8000 pieces, giving 160,000 pieces in all, the value of which is certainly above L.500,000. (Wakefield, I. 694.)

In the neighbourhood of Belfast and Leitrim, this manufacture has diffused happiness and prosperity; but in the remote districts of Mayo and Sligo, the effect upon the labouring poor has been just the reverse. So strongly does this appear, that Mr Wakefield gives it as his decided opinion, that the extension of the linen manufacture over the whole island, would bring with it an extension of poverty and famine, and would, if continued for any length of time, be the greatest curse which could be entailed on the country. (*Ibid.* I. 699.) It is remarkable, too, that this manufacture is solely the growth of artificial encouragement: for such is either the national aversion to industry in general, or to this branch of it in particular, that nothing is done without the assistance of government. A spinner, to be industrious, must be presented with a wheel; a weaver, before he will work, must be supplied with a loom; a bleacher to carry on his work, must be presented with a house in Dublin, for the purpose of selling his commodity. (*Ibid.* 698.) The following is a table of the sums expended in bounties by the trustees during the undermentioned years.

Years.	L.	Years.	L.
1802	13,857	1807	16,978
1803	8,861	1808	11,184
1804	13,064	1809	7,302
1805	11,423	1810	21,768
1806	13,243	1811	17,819

The *Cotton* manufacture was introduced into Ireland by Messrs Joly and M'Cabe in 1785, and seems, from the following table, to have taken a pretty strong root. Cotton Manufacture.

	Cotton Wool. Cwt.	Cotton Yarn. Lbs.
Average importation of cotton for three years, ending 1799,	10,983	460,013
Ditto 1807,	17,782	1,223,081
Ditto 1810,	32,257	1,057,115

This manufacture is principally carried on in the neighbourhood of Belfast, where, in the year 1809, it appeared, that in a circle of 10 miles it employed 27,000 persons. It has also spread to Dublin, Kil-

Ireland.

dare, Wicklow, Wexford, and Louth. At Coulon in Louth, there are 1300 looms employed in calico weaving. Upon the whole, this branch of industry is spreading rapidly in Ireland, and promises, at no distant period, to become a staple article of manufacture. (Wakefield, I. 705.)

Woollen Cloths.

The woollen manufacture does not exist to any considerable extent. It was formerly depressed and checked by the jealous commercial policy of England; and, though the Union has placed the two countries on an equal footing in this respect, the superior wealth and commercial enterprise of England have prevented all successful competition. Between 1794 and 1809, the total number of pieces exposed to sale, in the Woollen Hall of Rathdrum, did not exceed 55,000. The manufacture of woollen, however, in a coarse way, for their own consumption, is carried on to a great extent by the people. In many parts of the country the great mass of the labouring poor manufacture their own woollen cloths. In some places the women not only make stockings, petticoats, &c. for their children, but some coarse woollen articles for sale. (Wakefield, I. 710; *Survey of Clare*, 179; *of Kilkenny*, 523.)

The manufacture of gloves, especially those called "Limerick gloves," is carried on to a considerable extent. Iron was formerly wrought to good profit and in great quantities; but all the founderies are now in disuse. Hardware articles, however, are manufactured at Dublin, and coarse implements of husbandry at Carlow. (*Ibid.* I. 721.)

Distilleries.

The Distilleries of Ireland are very extensive, and the quantity of spirits made at the unlicensed stills, in all probability, still more considerable. In five years, from 1802 to 1806, 13,159 unlicensed stills were seized in Ireland, and 11,098 heads, and 9732 worms. The principal licensed distilleries are established at Limerick, Cork, Ross, Dublin, and Drogheda. In the year 1808, the greatest licensed distiller in the kingdom made 17,000 gallons a-week, and kept his distillery working between nine and ten months in the year. The following table exhibits the quantity of corn spirits for which duty has been paid in Ireland for ten years previous to January 5, 1813.

		Gallons
Year ending January 5.	1804,	4,426,085
Ditto,	1805,	3,611,512
Ditto,	1806,	3,756,671
Ditto,	1807,	3,931,829
Ditto,	1808,	5,707,158
Ditto,	1809,	5,613,751
Ditto,	1810,	72,996
Ditto,	1811,	4,719,159
Ditto,	1812,	6,500,561
Ditto,	1813,	4,085,913

During the greater part of 1810 distillation was prohibited. From September 29, 1816, to February 5, 1817, there were 235,347 barrels of corn of 12 stone each used in distilling.

Breweries.

It is but of late years that public breweries have been established in Ireland, but they have spread to a great extent. The principal breweries are at Cork, Fermanagh, Limerick, Waterford, Roscommon, Dublin, Belfast, Cavan, Armagh, Donemore, and Dungarrow; one of the largest brewers in the island brews upwards of 100,000 barrels *per annum*. The following table shows the quantity of malt used in the breweries and distilleries from 1804 to 1817.

Year ending January 5.	1804,	905,649
Ditto,	1805,	715,479
Ditto,	1806,	705,111
Ditto,	1807,	717,232
Ditto,	1808,	601,561
Ditto,	1809,	662,019
Ditto,	1810,	753,981
Ditto,	1811,	612,850
Ditto,	1812,	683,146
Ditto,	1813,	562,234
Ditto,	1814,	———
Ditto,	1815,	804,327
Ditto,	1816,	679,018
Ditto,	1817,	479,033

Export of Manufactures.

Linen.

The *Export of Manufactures* has increased very greatly within the last 10 years. The following table shows the progressive increase in the export of *linen*, the staple commodity of the kingdom, during the last, and that part of the present century which has elapsed:

		Yards.
Average from	1700 to 1750,	1,000,000
	1750 to 1756,	11,796,361
	1757 to 1763,	14,511,973
	1764 to 1770,	17,770,862
	1770 to 1777,	20,252,239
1. Year ending 25th March	1800,	35,676,908
¾ to 5th Jan.	1801,	25,141,516
to 5th Jan.	1802,	37,767,077
	1803,	35,491,131
	1804,	36,432,365
	1805,	42,988,621
	1806,	43,534,971
	1807,	39,049,727
	1808,	40,901,442
	1809,	43,904,382

And in the year 1819, there was exported to Great Britain alone 38,038,182 yards of plain, and 1837 of damask linen.

The following table shows the official value of the linen exported from Ireland in different years, from 1809 to 1820.

Years		Years	
1809,	L.2,033,109	1813,	2,389,722
1810,	2,178,869	1818,	3,144,806
1811,	2,460,380	1819,	3,132,454
1812,	2,095,657	1820,	2,317,417

Of this quantity, it is computed that upwards of L.2,000,000 annually comes to Great Britain. Spain takes nearly L.100,000 annually; the West Indies, in 1815, received upwards of L.100,000, and the United States, in 1811, no less than L.180,000.

Ireland.

Export of Cotton.

The Official Value of the Cotton Goods exported in

1811, was	L.93,482
1812,	23,640
1818,	68,537
1819,	43,751
1820,	54,777

Cotton Wool.	Imported. Cwts.	Exported. Cwts.
1810,	49,786	11,454
1811,	53,133	16,148
1812,	47,122	4,709
1813,	26,109	6,891
1814,	30,162	16,285
1815,	20,551	12,455

Export of Spirits.

The export of *Spirits* was, on an average of seven years, ending

	Gallons.
25th March 1796,	10,284
Do. 10th Oct. 1802,	950,180
1803,	990,898
1804,	917,476
1805,	1,121,968
1806,	550,441

The great export of Irish spirits is to foreign states. The quantity exported to Great Britain, in 1819, was only 107,026 gallons.

Immense numbers of goose quills are annually sent from Ireland to this country. Those exported to Great Britain, in 1819, amounted to 9,541,320.

Commerce and Shipping.

The following tables exhibit a general view of the Commerce of Ireland from the year 1777 to the year 1815:

Official Value of Imports.

Average of Three Years, ending 25th March.	From Great Britain.	British Colonies.	All other Countries.	Total.
	L.	L.	L.	L.
1777,	1,949,420	161,058	651,820	2,762,298
1783,	2,334,900	76,184	631,938	3,043,021
1793,	2,753,969	242,995	1,168,020	4,164,985
1800,	3,727,859	146,069	783,885	4,657,784
Year ending 5th of Jan.				
1811,	5,464,951	658,071	932,192	7,055,214
1815,	6,930,370	586,927	652,523	8,170,820

Official Value of Exports.

Commerce and Shipping.

25th March	To Great Britain.	To British Colonies.	Other Countries.	Total Irish Produce.	Total Foreign Goods.	General Total.
	L.	L.	L.	L.	L.	L.
1777,	2,494,455	287,628	401,889	3,153,181	30,791	3,183,992
1783,	2,300,671	315,798	460,976	3,054,680	22,766	3,077,446
1793,	4,039,581	271,145	715,259	5,060,040	65,944	5,125,984
1800,	3,778,520	265,629	306,491	4,225,254	125,586	4,350,640
5th Jan.						
1811,	5,159,884	304,954	458,557	5,525,606	397,507	5,923,113
1815,	5,731,119	443,781	913,856	6,614,646	474,110	7,088,756

Imports into, and Exports from, Ireland for three Years, ending 5th January 1820.

	Official Value of Imports.			Official Value of Produce and Manufactures of the United Kingdom exported from Ireland.			Official Value of Foreign and Colonial Merchandise exported.		
	L.	s.	d.	L.	s.	d.	L.	s.	d.
Year ending 5th Jan. 1818,	5,644,175	16	5½	6,412,892	10	2	150,562	7	8½
1819,	6,098,720	2	7½	6,436,950	14	11¾	84,078	9	8¾
1820,	6,395,972	17	5¾	5,708,582	15	7¾	61,882	12	2¾

The *real* value of the produce and manufactures of the United Kingdom, exported from Ireland in the year ending 5th January 1820, computed at the average prices current, amounted to L.9,747,206, 1s. 1¼d.

Ireland.

Shipping.

The following tables show the present state of the Shipping of Ireland:

Number of vessels belonging to Ireland, with the amount of their tonnage and men, on an average of 3 years, ending 30th September	Ships.	Tons.	Men.
1790	1076	64,157	6335
1800	1009	51,358	4937
1810	1116	59,584	5430
One year 1818	1300	68,793	6204
1819	1288	69,283	6283

Number of vessels built and registered in Ireland, on an average of 3 years, ending 5th January		Ships	Tons.
	1790	63	2531
	1801	20	1285
	1811	28	1403
	1815	45	1992
One year ending 5th January	1815	46	1973
Do.	1819	48	2283
Do.	1820	37	1606

That the trade of Ireland has not decreased since the peace of 1814, is evident from the following table

INWARDS.

	Irish.			British.			Foreign.		
	Ships.	Tons.	Men.	Ships.	Tons.	Men.	Ships.	Tons.	Men.
1815	2069	142,690	9282	7800	707,222	40,379	296	51,755	2990
1816		157,283	10,175	7984	693,107	39,921	501	92,474	5037
1817	2016	153,637	9377	7864	690,165	39,696	323	68,674	3441

OUTWARDS.

	Irish.			British.			Foreign.		
	Ships.	Tons.	Men.	Ships.	Tons.	Men.	Ships.	Tons.	Men.
1815	1937	139,302	9118	8690	693,422	40,130	274	50,708	2617
1816	2187	153,354	9917	7782	684,179	39,259	511	98,115	5007
1817	1931	139,827	9058	7200	641,205	36,180	350	75,546	3633

REVENUE, EXPENDITURE, DEBT.

Revenue of Ireland

The REVENUE of Ireland is principally derived from customs, excise, stamps, and post office duties, and from assessed taxes on hearths, windows, houses, carriages, servants, and horses. The income-tax was never introduced into Ireland.

By the treaty of Union between Great Britain and Ireland, the latter was bound, besides paying the interest of the debt contracted before that period, and other separate charges, to make good 2/17ths of the public expenditure of the empire. This proportion was soon found to be much too great for her means. Notwithstanding a very great increase of taxation, the debt of Ireland increased so fast, that its interest generally amounted to about as much as, and frequently exceeded, the total revenue of the country. In this situation, and as the only means of avoiding a public bankruptcy, a proposition was submitted to Parliament for the consolidation of the English and Irish Exchequers. This measure was carried into effect in 1816. The debt of Ireland was incorporated with that of Great Britain; and, since the 5th of January 1817, the incumbrances, revenues, and expences of the two countries have been blended together in one mass. The produce of taxation in Ireland is now considered merely as making a part of the general income of the empire, without any regard to the arbitrary proportion fixed in the treaty of Union.

The following is a View of the Revenue and Expenditure of Ireland in different Years.

Permanent Revenue.			Expenditure.	
	Gross Produce.	Net Payment.	1792	L.1,514,258
1791	L.1,805,961	L.1,184,684	1800	7,201,231
1800	3,445,718	2,805,536	1805	8,043,761
1806	4,193,915	3,364,137	1810	9,348,476
1815	6,937,558	5,525,699	1815	13,326,433

The total gross Revenue for the Year ending 5th January 1817, the year previous to the Consolidation of the Exchequers, derived from the following branches, amounted to

Customs,	L.2,082,043
Excise,	3,208,931
Stamps,	611,709
Post-office,	222,747
	L.6,125,430

Expence of collecting the Revenue

The *total expence* of collecting the various branches of the revenue of Ireland for the same year amounted to L.1,014,342. The following is a statement of the rate *per cent.* at which this expence was incurred, viz. for every L.100 paid into the Treasury under the heads of

		L.	s.	d.
Customs,	There was paid for expence of collecting	L.35	11	3
Excise,		14	3	4
Stamps,		10	2	6
Post-office,		149	19	10

Expenditure.

Separate Expenditure for the same Year.

Interest of debt,	L.4,399,160	14	
Charges of management,	30,305		
Sinking Fund,	2,434,127	13	
Interest on exchequer bills,	126,500	0	
Issues for the separate service of Ireland,	3,836,869	16	
Do. for local purposes,	43,690	12	

Joint Expenditure along with Great Britain.

Civil list, pensions, &c	584,066	15	
Payments in anticipation of exchequer receipts,	35,523	15	
Ordnance,	140,000	0	0
Army,	2,368,827	15	1¾
Miscellaneous services,	592,626	8	6½
Vote of credit, arrear of 1815,	20,261	9	9¼
Total,	L.14,612,560	6	4¼

Ireland.

Debt.

The debt of Ireland, which, in 1800, amounted to about 25 millions, had increased in 1817 to about 152 millions, of which L.141,441,180 was funded.

Oppressiveness of Taxation.

Perhaps no country has suffered so much as Ireland from the oppressiveness of taxation. Since 1808 taxes have been imposed in that country, which our finance ministers estimated would produce *three and a half* millions. In point of fact, however, they have not produced a single shilling. The nett revenue of Ireland in 1808 amounted to L.4,417,990, while, in 1820, it only amounted to L.3,605,446, being a decrease of L.812,544. This fact affords a striking illustration of the folly of endeavouring to raise an additional revenue from an impoverished and exhausted country by a mere increase of taxation. Had Government made any vigorous effort to stimulate the dormant energies of the people, to give them a taste for the comforts and luxuries of civilized life, or to remove the most obvious of those causes of irritation and idleness which have so long distracted and depressed one of the finest countries in the world, the result would have been very different. But they contented themselves with adding to burdens which were already too heavy to be borne. The necessary consequences followed; consumption was diminished, the revenue declined, and all classes have been sunk deeper in the abyss of poverty and misery.

Public Schools and Charities.

Schools and Charities

Notwithstanding the universal ignorance of the Irish poor, *the means of education*, within their reach, are by no means inconsiderable. It appears from the reports of the *Parliamentary Commissioners*, who have inquired into this interesting subject, that " there are 33 classical endowed schools in Ireland, besides 14 of private foundation, which educate nearly 1000 scholars: that, exclusive of parish schools in the city of Dublin, and in other places, supported by private endowments, amounting in number to 72, there are 44 public establishments for the education of the lower orders, in which 4200 children are lodged, maintained, clothed, and educated. The annual expence of these establishments is about L.70,000." (*Report of Commissioners on Education.*)

The following returns, as to the number of schools actually taught, have been obtained from 17 out of the 22 dioceses into which Ireland is divided.

Dioceses.	Number of Schools kept by Masters who are Protestants.	Number of Schools kept by Masters who are Catholics.	Number of Scholars who are Protestants.	Number of Scholars who are Catholics.
Ardagh,	21	104	1068	4310
Clogher,	120	221	5702	5588
Cashel and Emly,	31	191	746	10,815
Cork and Ross,	78	103	2082	5401
Cloyne,	36	143	952	9347
Dromore,	105	[illegible]	3806	1710
Clonfert & Kilmacduagh,	7	61	223	2741
Down & Connor,	286	90	10,260	3619
Derry,	154	136	5855	3275
Elphin,	23	110	1101	4651
Leighlin,	16	144	1121	7691
Ferns,	53	161	2406	9635
Killaloe & Kilfinora,	43	176	1435	10,077
Kilmore,	36	113	2031	4050
Meath,	91	231	2195	12,225
Ossory,	19	64	299	2841
Raphoe,	73	72	2381	1878
Tuam,	23	112	633	6972
Waterford & Lismore	29	159	1001	10,162
Total,	1271	2465	15,590	116,977

From these returns, it appears that, exclusive of the charitable foundations, the number of children taught in these dioceses amounts to 200,000, that the schools of the two religions are 1600; and that there are, at an average, 45 scholars to a school. As these returns were made in winter, when many children cannot attend, and do not, besides, include the itinerant schoolmasters, it is probable, that the total number of children taught is more considerable. The instruction, except in a very few instances, goes no farther than reading, writing, and the common rules of arithmetic; and the fees paid, on an average are 10s. *per annum* for reading, 17s 4d. when writing, and L.1, 6s. when arithmetic is added. (*14th Report of Commissioners on Education.*) These facts prove, that the means of education are afforded to the labouring poor; but they by no means show that the people gain any useful information, or are at all advanced in the scale of moral beings, by this instruction; nor do they supersede the necessity of a national establishment comprehending every parish in the island.

Ireland has no poor's rate; but in its principal cities a variety of most extensive charities are established. Many of them are maintained by the charity of individuals, and others by the munificence of government.

The following is a statement of the sums granted by the British government in the year 1818 to some of the principal charities and public establishments of the country

Protestant Charter Schools,	L.38,331
Foundling Hospital,	32,515
House of Industry,	36,643
Richmond Lunatic Asylum,	7,085
Fever expences,	12,000
Police of Dublin,	26,600
Westmoreland Lock Hospital,	8,307
Dublin Society,	9,230
Society for Educating the Poor,	5,538

Ireland.

Chap. II.

General Observations on the Condition of the People, and the Causes of their Depressed State.

All travellers who have inquired into the condition of Ireland, unite in representing the redundance of the population as the main source of the sufferings of the people.* One cannot pass through a single county, without perceiving the most grievous effects resulting from this cause. In every town, in every village, there are multitudes of beggars, whose importunity testifies the need they have of assistance, while their famished and anxious aspect marks, in language not to be misunderstood, the anguish and suffering to which they have been subjected. The rich may exclaim against the impositions of the poor, and refuse charity to a hundred real objects of distress, because two or three have magnified their sufferings; but whoever will scrutinize the condition and appearance of the Irish poor will be convinced, that their miseries can hardly be exaggerated.

Nor is it merely in the incredible numbers, the incessant importunity, and deplorable aspect of the Irish beggars, that the superabundance of the population appears. It is an evil which is felt in every occupation, and in every corner of the land. In every line of life, in every branch of industry, there is an excessive competition for employment. If a small farm is to be let, the landlord is beset by numbers of persons wishing to take it; and who, in their anxiety to fix themselves somewhere, offer the exorbitant rent of L.5, L.6, and even L.8 *per* Irish acre for land, which, under their system of management, will hardly produce this sum. It is from this cause that the number of Cottars is so inconceivably great, and that such high rents are given for the smallest pieces of potatoe land. In every other employment the same symptoms of a redundant population appear; and it is well known in the adjoining countries of England and Scotland, that wherever any public work is undertaken, there is almost instantly an inundation of Irish poor, seeking that employment which they cannot obtain at home.

Emigration, as might be expected, prevails, and has long prevailed, to a great extent in Ireland; but it has been unable to retard the progress of population. Between the years 1690 and 1745, it is computed that 150,000 Irishmen perished in the service of France alone. (Newenham's *Ireland*, 58.) Every nation almost of Europe has Irishmen in its service, and, independently of the vast swarms which continually come over to Britain, upwards of 1000 have annually, for a long period back, emigrated to America. (*Ibid.* 59.) During the year 1818, when the distress of the country was very great, the emigrants to America swelled to the enormous number of 20,000. (Newenham, 59; Wakefield, II. 712.) But this drain, great as it undoubtedly is, and materially as it must affect the population, from being composed entirely of persons in the prime of life, is not perceived amidst the multitudes who remain. Every employment is still thronged to excess; and the departure of those who emigrate retards rather than accelerates the progress of wealth, for those who go have all acquired some little capital, and habits of industry, the subduction of which dries up the springs of national prosperity.

Ireland.

The actual population in 1805 has been estimated, by Mr Newenham at 5,400,000 souls. Mr Wakefield, after demonstrating, that, in 1791, it amounted to 4,200,000, observes that, since that period, a very great increase has taken place. (Wakefield, II. 712.) The rate of increase has been estimated by Mr Newenham and Mr Wakefield at an annual addition of one-forty-sixth to the whole population, in other words, the numbers of the people double in forty-six years. (Newenham, 220. Colquhoun, 21.) Thirty years ago, Mr Young expressed his astonishment at the prevalence of early marriages in this country. (Young, II. 198.) Mr Newenham and Mr Wakefield have reiterated the same observation in their late publications. Every road is lined with cottages, every cottage swarms with children. Under circumstances of unexampled distress during the last three years, the number of marriages and the multitude of children have suffered no diminution.

As might be expected in a country where the increase in the numbers of mankind has so far outstripped the progress of its wealth and the increase of its industry, the condition of the people is in every department marked by extreme indigence. (Dewar, 91; Young, II. 125.) The houses in which they dwell, the furniture in their interior, their clothing, food, and general way of life, all equally indicate the poverty of the country. In these respects, however, some improvement was observable, even at the time when Mr Young's *Tour* was written, and it has gone on increasing to a certain extent since that period. In the south of Ireland, the cottages have, in many instances, feather-beds, a luxury which they owe to the numbers of geese and poultry with which the country abounds,—a plenty which, in some degree, compensates to them for the many other privations to which they are subject. Considerable improvement in the condition of the peasantry was beginning to take place in the south towards the conclusion of the war, in consequence of the immense market and high prices which the consumption of the army and navy afforded; but these dawnings of prosperity have been almost totally overclouded by the distress of the last years.

It appears from evidence laid before a Committee of the House of Commons, that, in the year 1817, there were in Nicolson's Court, Dublin, 151 persons crowded into 28 small rooms; of these 89 were unemployed, and there were only *two bedsteads and two blankets in the whole Court.* In Barrack Street were 85 houses, the apartments in which were extremely crowded: 52 houses contained, in 390 rooms, 1318 persons, of whom 332 were adults

* Young's *Ireland*, II. 197; Dewar's *Ireland*, 94; Newenham, *passim;* Wakefield, *pass.*

out of employment, the greater part of whom were in extreme indigence. Church Street contained 181 houses, which were greatly more crowded than in Barrack Street.—In 71 houses of this street, and the adjoining courts, no less than 1997 persons were lodged in 393 apartments; of these 123 had been infected by fever within three months. There are many cellars in these houses which have no light but from the door, which, in several, is closed only by bundles of rags, vegetables, and other articles. In these cellars the people sleep on the floors, which are all earthen.

The dress of the people is so wretched, that, to a person who has not visited the country, it is almost inconceivable. Shoes or stockings are seldom to be seen on children, and often not on grown persons. (Young, II. 121.) The rags in which both men and women are clothed are so worn and complicated, that it is hardly possible to imagine to what article of dress they have originally belonged. It has been observed that the Irish poor never take off their clothes when they go to bed; but the fact is, that not only are they in general destitute of blankets, but, if they once took off their clothes, it would be difficult to get them on again. Their dress is worn day and night till it literally falls to pieces; and, even when it is first put on, it is usually cast-off clothing; for there is not one cottager out of ten who ever gets a coat made for himself. A considerable trade has long been carried on from the west of Scotland to Ireland, consisting of the *old clothes* of the former country, and to those who know how long all ranks in Scotland wear their dress, there is no more convincing proof of the poverty of the latter country can be given.

In England, markets and shops are established in every quarter, where the people may buy their necessaries and conveniences. In Ireland there is neither the one nor the other. The Irish poor, indeed, have no conception of the comforts of life, and if they felt their full value, they could not afford them, for though necessaries are cheap, conveniences of all sorts are very dear. Owing to the deficiency of manufacturing capital, the price of the commonest articles is fully as high as in Britain, while the money wages of labour are not equal to half the earnings of the English labourer; being in general from 8d. to 1s. 2d.; a sum altogether inadequate to obtain any portion of the comforts of life.* (Newenham, 272, 273.)

But while the Irish poor are in general destitute of all the accommodations, they hardly ever, except in years of extraordinary distress, know what it is to want the *absolute necessaries* of life. The unsparing meal of potatoes, at which the beggar, the pig, the dog, the poultry, and the children, seem equally welcome, seldom fails the Irish labourer. In many cottages, the potatoe pot is constantly on the fire, and the children help themselves when they please (Young, II. 121); and to this cause, joined to the general use of milk, is to be ascribed the healthy appearance of the children in cottages which would seem to be the abode of the most abject misery.

The laziness of the lower Irish is very great (Wakefield, II. 776.) In many places it is so excessive, that two shillings a-day in England would be cheaper in the end than sixpence in Ireland (Young, II. 117.) This cannot be imputed to their potatoe diet, for there are numerous instances of persevering industry in Ireland. It is owing to the habits, the mode of payment, and the occupations of the labouring classes. Limited as their wants are to the mere support of animal life, they do not engage in labour with that persevering industry which artificial desires inspire; and the mode in which they are often paid, that is, the giving them a piece of potatoe land by the year, at once furnishes the means of subsistence, and takes away every stimulus to farther exertion. The farm-servants of the English or Scotch farmers, who carry on agriculture upon the improved system, are constantly employed in some species of labour; but after the potatoes of the Irish cottar are planted, there is hardly any thing to be done about his little croft till the season of digging arrives. During a great portion of the year he is doomed to idleness, and the habits he acquires during these long periods of almost total inaction, are too strong to be overcome when he is transferred to a more regular occupation.

* There is no person who has visited Ireland who must not be convinced that, *generally* speaking, these observations are strictly true. But, though the general aspect of the country is that of poverty and wretchedness, yet there are particular districts in which the progress of improvement has been so rapid and striking as to afford the most animating prospects; and even over the whole country, the increased consumption of articles of comfort, during the last twenty years, is very remarkable. "That Ireland," says Wakefield, "has made a wonderful progress in improvement, will not, I think, be denied by the gloomiest politician. In the neighbourhood of Belfast, this change has been peculiarly striking. This town, which, about a century ago, hardly deserved notice, is now, in trade and consequence, the fifth in the kingdom, hundreds, whose food consisted chiefly of potatoes, now use wheaten bread; thousands sleep in blankets and sheets who were formerly contented with a covering of straw. Having been frequently in Ireland during the last thirty years, my own observation has convinced me that a considerable change of habits has taken place, and that a taste for a more refined mode of life is beginning to diffuse itself among the people." (Wakefield, II. 65.) From the official return of the imports into Ireland from 1772 down to 1811, it appears that a prodigious increase in the consumption of articles of luxury has taken place in that period; far greater than the augmentation during the same time in the numbers of the people. (*Ibid.* II. 58.)

Ireland. Such is the condition of the labouring classes. Ireland exhibits the extraordinary example of a country, in which, under the most distressing circumstances, population has advanced with the most rapid pace; in which cultivation has advanced without wealth, and education without diffusing knowledge; where the peasantry are more depressed, and yet can obtain subsistence with greater facility than in any other country of Europe. Their miserable condition will not appear surprising when the numerous oppressions to which they are subject are taken into consideration.

In the foremost rank of their many grievances, the general prevalence of Middlemen must be placed. It is difficult to estimate the extent of the misery which the system of letting and subletting land has brought upon the Irish cultivators. It has been observed, that the great cause of the prosperous situation of the peasant in Japan, is, that he pays his rent at once to the sovereign; that no person is substituted between the cultivator of the ground and the great landholder. (Thunberg's *Travels*) With truth it may be said, that one great cause of the misery of the Irish peasant is to be found *in the number of persons* who are interposed between the landlord and the cultivator; for the whole fruits of their labour finds its way into the pockets of this middle class. (Wakefield, I. 287.) To absent landholders, middlemen are almost unavoidable; for without their intervention their estates could not be managed, and the collection of rents would be impossible. Middlemen have, in every country, been the inseparable attendants of *absent* proprietors: and in such a country as Ireland, where there are numbers of disaffected persons in every quarter, the vigilant eye of a superior inspector is more particularly required.

By the law of England, the landlord is entitled to distrain for payment of rent, not only the stocking which belongs to his immediate tenant, but the crop or stocking of a subtenant; on the principle, that whatever grows on the soil ought to be a security to the landlord for his rent; and in Scotland the same rule holds where the landlord has not authorised the subtack; but if he has, the subtenant is free when he has paid to the principal tenant. There is little hardship in such a rule in England, where the practice of subletting is, generally speaking, rare; but when applied to Ireland, where middlemen are universal, it becomes the source of infinite injustice; for the cultivator being liable to have his crop and stocking distrained on account of the tenant from whom he holds, and there being often many tenants interposed between him and the landlord, he is thus perpetually liable to be distrained for arrears not his own. The tenant, in a word, can never be secure, though he has faithfully paid his rent to his immediate superior; because, he is still liable to have every thing which he has in the world swept off by an execution for arrears due by any of the many leaseholders who may be interposed between him and the landlord. It is obvious that such a system must prevent the growth of agricultural capital. This, joined to the exactions of the middlemen, has been the true cause of the universal prevalence of the cottage system, and the minute subdivision of farms. Ireland.

The mode in which the poorer classes are treated is strongly descriptive of their depressed situation. "The labouring poor," says Mr Young, "are treated with great harshness, and are in every respect so little considered, that their want of importance seems a perfect contrast to their situation in England, where, comparatively speaking, they reign as sovereigns. The landlord of an Irish estate, inhabited by Roman Catholics, is a despot, who yields obedience, in whatever concerns the poor, to no law but his own will. The language of the law may be that of liberty, but the situation of the poor may speak nothing but slavery. There is too much of this contradiction in Ireland. A long series of oppressions, aided by many very ill judged laws, have brought landlords into a habit of exerting a very lofty superiority, and their vassals into that of unlimited submission. Speaking a language which is despised, professing a religion which is abhorred, and being disarmed, the poor find themselves in many cases slaves, even in the bosom of written liberty." (Young, II. 127.)

In England, the Tithes can hardly be said, in a national point of view, to amount to a grievance. The precarious situation of the clergyman, possessing only a life interest in the benefice, joined to the wealth and consequence of the farmers and landholders by whom he is surrounded, precludes him, in the general case, from exerting his rights to their full extent, and softens the evils which the abstract powers with which he is invested might otherwise produce. But, in Ireland, the case is far otherwise. The relative situation of the farmer and of the clergyman are totally different, and a very different system in regard to the collection of tithes is pursued. The clergyman is, in general, far richer than any farmer in his parish; and he is connected with the Protestant interest, which has so long exercised an unlimited sway. Independently of the extreme poverty of the farmers, the livings in Ireland are, in general, much larger, and more lucrative than in England; so that the relative situation of the clergyman and his parishioners is totally different in the two countries. From the wealth and influence of the clergy, joined to the destitute situation of their parishioners, the tithes have long been collected with a severity, of which hardly any European state furnishes an example. They fall, by the law of that country, only on the tillage land, the greater part of which is held by cottar tenants; and thus the rich are exempted from bearing their share of the burden. (Wakefield, II. 486.) Almost everywhere the tithes are let to Tithe Proctors, who are acquainted with every man in the parish, who know the utmost length to which extortion can go, and exercise their powers with the most merciless severity. These proctors, besides what they pay to the clergyman or lay-improprietor, realize large incomes to themselves out of the produce of their extortions. When it is recollected, what savage ferocity has always been exercised towards these collectors in

every commotion, it may be conceived how deeply their severity has been felt. (*Ibid.* II. 486, 487.)

What renders the tithing system peculiarly oppressive in Ireland is, that its exactions fall upon cottars who give the full value of the land in the rent paid to the landlord. The number of the labouring classes is so great, and the other branches of industry in comparison so inconsiderable, that the unfortunate poor are driven to take little spots as their only means of subsistence. The competition between them is so excessive, that they offer the highest possible rent for the land; as much, indeed, as the whole produce is worth, after their own food is deducted. The tithe is not considered by these unfortunate people; or if it is, they trust to the chapter of accidents for the means of paying it. But even if they had all the foresight of the Scotch peasant, they could not do otherwise; for having no other means of living, and being too poor to emigrate, they are compelled to run against each other for little farms; and of this competition the landlords too often avail themselves to screw the rent to the highest possible rate which the poor can afford to pay. (Wakefield, II. 493.) When the cup of misery is full, a drop will make it overflow. The tithes in Ireland are this drop. Inconsiderable as they are when compared with the burden which the tenants have to sustain in their rent, yet, when placed *in addition* to it, they operate as the last and most grievous oppression with which they are afflicted. To this cause we are to impute the remarkable fact, that while in Munster, where the tithe of potatoes is exacted, frequent risings have occurred during the last forty years; in Ulster, where no tithe is required, risings are unknown. (Wakefield, II. 493; *Life of Lord Charlemont*, 87, 88.)

What increases the hardship of this burden upon the people is, that it is not only imposed to support an establishment which they detest, which they consider as the badge of their national subjection, and which is so often negligent of its duty; but that it is an addition to a very expensive ecclesiastical establishment of their own, which they are obliged to support. The Irish Roman Catholic clergy, a numerous and not indigent body, are supported *entirely* by the contributions of the people; and the greater part of the income of the Presbyterians in the north is derived from a similar source. On occasion of a marriage, the priest receives from these poor people from two to three guineas; and the difficulty of raising this sum is perhaps the only check on the progress of population. (Newenham, p. 51.) From this and other sources the income of the Irish Catholic clergy is, except in years of extraordinary distress, very considerable; and this is a burden which falls solely on the poorer classes. Thus are the Irish peasantry, who, of all nations in the world, are the least able to support it, burdened with two separate ecclesiastical establishments, each of which levies its dues with the most rigid exactness; the one armed with the terrors of temporal authority, the other with the still more formidable weapons of superstition.

Another grievance, though not so extensive, is the fine imposed upon a township, for having had the misfortune to have a seizure for illicit distillation made within its bounds. Numerous are the families which have been utterly ruined, in every part of the country, by this most oppressive law. Many individuals are now languishing in prison who have been seized for the fine imposed on their township for an illicit still, of which they were utterly ignorant, or which they may have made the most vigorous though ineffectual, efforts to oppose.

From the facts collected by Mr Chichester (Chichester *on Still Fines*) on this interesting subject, it appears, that during seven years, from 1809 to summer 1816, the still fines levied amounted to L.356,925, or L.50,989 a-year; and the evidence of Sir John Stewart before the House of Commons shows, that, from 1809 to 1815, L.26,825 has been levied upon the county of Tyrone alone, and, on the county of Donegall, L.72,540. It appears, from the same authority, that the stills are of such a nature as to be generally incapable of discovery; that no provision is made for the case of absentees, who have, in more than one instance, been ruined by fines levied on their estates, while abroad on the service of their country; that the power thus vested in the hands of the revenue officers has been the occasion of infinite individual distress, as well as public discontent; and that the fines are levied, in general, by military force, and terminate in the utter ruin of the peasantry on whom they fall.

These evils have been attended with the usual depressing effects of oppression. They have prevented the growth of any artificial wants, or any desire of bettering their condition among the mass of the people. Despised by their superiors, and oppressed by all to whom they might naturally have looked for protection, the Irish have felt only the natural instincts of their being. Among the Presbyterians of the north, and in the vicinity of manufacturing towns, higher notions of comfort may have imposed some restraint on the principle of population; but the poor humiliated Catholics, enjoying no respectability or consideration in society, have sought only the means of subsistence; and finding, without difficulty, potatoes, milk, and a hovel, have overspread the land with a wretched race.

To these causes of a redundant population, of which the government of the country is, directly or indirectly, the source, are to be added others, of a different kind.

The first is the influence of the parish priests, who encourage marriage in order to increase their own emoluments, and the superstition of the people, who regard it as a religious duty. (Wakefield, II. 690.) In a country where the priests possess so much control over the lower ranks, and where the influence of artificial wants is so little felt, this circumstance must have a powerful effect. To this cause, joined to the degraded situation of the Catholic population, is to be ascribed the much greater frequency of marriages among the lower orders of that persuasion than among the Protestants. (*Ibid.* II. 578.)

The second cause is the general ignorance of the

Ireland. people. On the influence of education, in restraining the tendency to early and imprudent marriage, it would be superfluous in this place to enlarge. It is a mistake to imagine, however, that this almost universal ignorance, of which so much has been said, by almost every writer on the state of this country, is the result either of any inaptitude of the people to learn, or of any very remarkable deficiency in the means of education. The Irish evince everywhere the greatest anxiety for education, whenever the means are afforded. In the remote mountains of Kerry, schools are sometimes found in the wildest situations, where rocks supply the place of desks and benches. (Weld's *Killarney*, 167.)

Nor are the means of education either limited or scanty. In every quarter of the country, schools are established, and the cottagers can, in general, get their children instructed for five or six shillings a-year, in reading, writing, and arithmetic. (Wakefield, II. 399.) In the dioceses of Cloyne and Rossalme, there are 816 parochial schools, attended during the summer by 21,892 scholars. It may, indeed, be affirmed, generally, that, in point of literary attainments, the peasantry are greatly above the same class of men in England. (Newenham.) Yet it is strictly true, that the Irish *are ignorant in the extreme.* The solution of this seeming paradox is to be found in the poverty of the people, the absurd books which are put into their hands, and the want of religious instruction.

The poverty of the people is so great, that after they have learned to read, they are in general unable to purchase any book, or they are bred up in employments where reading is difficult by reason of the continued labour in which they are engaged. (Wakefield, II. 398-9.) In fact, it is impossible that knowledge can make any great progress in a country where the poverty of the people is so extreme, and where they are content with the mere support of life. In such circumstances, they necessarily want both the means and the inclination to turn their education to any good account. The books which are put into the hands of the children, so far from being such as are calculated to train them to habits either of order, virtue, or self-restraint, are precisely the reverse; being legends of saints, or histories of thieves, smugglers, and prostitutes, calculated to lead the youth of both sexes into every species of violence and depravity! It has, accordingly, been often observed, that the lower Irish, though educated, are utterly deficient in moral and religious knowledge (*Survey of Cork*, 714; Wakefield, II. 404); and to this circumstance much of the violence and cruelty which prevails among them is to be ascribed.

Various other circumstances have combined, to multiply to a great degree the facilities of population, and to expand, in this country, beyond almost any other, the means of subsistence.

The first is the extraordinary fertility of the country, and the small expence at which cultivation can be conducted. Ireland contains 20,437,000 English acres, and of these above 13,000,000 are actually under tillage. The land does not require any expensive mode of culture; on the contrary, it is in general so rich, that it will yield an alternate crop of wheat and potatoes for ever; and can be taken into cultivation at a very small expence. But for this circumstance, the poverty of the Irish cottars, and the almost total want of agricultural capital, would have operated as a complete bar to a numerous population. Ireland.

The second is the introduction of the Potatoe and its singular adaptation to the soil of Ireland. That this root furnishes food to the greater part of the Irish poor is universally known; but its effects in expanding the means of human subsistence are not sufficiently considered. The average produce of the kingdom is 82 barrels *per* acre, each barrel weighing 20 stone. This amounts to 22,960 pounds, which, divided by four to bring it to the solid nourishment of wheat, will be 5740 pounds. The average produce of an Irish acre of wheat is four quarters, which, at 460 pounds to the quarter, is 1840 pounds, not one-third of the solid nourishment yielded by the same extent of potatoes. (Young, II. 120.) Mr Newenham considers three pounds of potatoes as equal to one of wheat; at this rate, the acre will yield four times as much nourishment under the potatoe, as when cropped with wheat.

Potatoes have been introduced into every kingdom of Europe as well as Ireland, but in no other have they become the staple food of the poor. It is the condition and habits of the people, as they are determined by political institutions, and other causes, which fixes the standard of comfort and the age at which they marry. The introduction of the potatoe, by expanding the means of subsistence, removes to a greater distance the ultimate check which the inability of raising an increase of food must impose upon the multiplication of mankind; but taken by itself, it has no tendency to make the population advance faster than their comfort requires. It facilitates the multiplication of mankind, and increases the rapidity with which population advances; but, unless the people are predisposed, from other causes, to press upon the means of subsistence, it has no tendency to augment their redundance. Under the government and political institutions of the Irish, the population of the country would have been equally *redundant*, though much *smaller* than it now is, if they had lived on oats or wheaten bread. The introduction of the potatoe may be the cause why the population is now six in place of three millions: but it is not the cause why, during the whole period of this increase, the numbers of the people have been greater than, under existing circumstances, could be comfortably maintained. (I. I. I.)

IRON-MAKING.

Iron-Making.

Discovery of Iron.

The first knowledge of Iron, it is not improbable, was derived from the discovery of a meteoric mass of this metal. Such mass, existing in a state of considerable purity, and capable of being hammered into form, may have exposed the first rudiments of those valuable properties which have been applied with so much ingenuity and labour to the advancement of human affairs. Tradition says that the discovery of iron took place in Greece, in consequence of the accidental burning of a wood. This is certainly a possible case, where there might happen to exist on the surface masses of iron ore, a circumstance not very uncommon. Perhaps it is a more probable conjecture to suppose that the discovery may have taken place, and been brought to a comparative state of perfection, in the process of converting wood into charcoal for domestic purposes. If the sylvan carboniser happened to pursue his art in a forest, occupying the surface of the mountain lime, abounding with ores of iron common to that formation, the casual introduction of masses of the ore in mixture with the covering matter of the fire would be unavoidable. In a fortunate moment, and under a happy conjuncture of circumstances, a lump might penetrate the ignited fuel,—a strong current of air might have arisen while the woodman slept,—an unusual temperature might thus have been excited,—and (though injurious to the result of his labours) iron might in this way have obtained its first artificial existence. Supposing a partial knowledge of its properties to have been derived from the meteoric mass, this would lead to its immediate application to similar purposes. The success of the experiment would, of course, depend upon the quality of the product,—similarity of surface or polish, would, for a long time, most likely be the only properties in common to both,—uniform malleability, and extension under the hammer, could only result from a regularly constructed furnace, governed by long experience, and certain established rules of process.

Air-bloomery.

Until the invention and use of bellows, the *Air-bloomery* seems the only mode by which iron could have been obtained. To say what was the first form or shape of this furnace is impossible. Such furnaces have long since ceased to exist in this country, and it is only by the remains of scoria, in elevated situations, that their former existence may be inferred. Park represents the air-bloomery of the Africans as a low [illegible] structure, containing, within very narrow limits, the aperture for admitting the air, and passing off the ignited gas. Air-bloomeries are still in use in Spain, and on the shores of the Mediterranean, where the ores of Elba are worked to considerable extent.

The rationale of this process is the deoxydation of the ore, by means of the contact of heated charcoal. To produce a beneficial result, it is necessary to use ores rich in iron, and united with as small a dose of oxygen as possible. The ores are stratified, and covered with charcoal, which is from time to time replaced as it becomes wasted by the progress of combustion. The ores during the lower degrees of heat, and period of deoxydation, are sheltered as much as possible from contact with the air. When the metallic particles are developed, an increased temperature is then necessary to unite the masses, and then exposure to air facilitates the process of welding. Lumps of the coalesced ore, impregnated with its earthly parts, and a portion of the iron in the state of scoria, are then taken from the furnace, and hammered into a rough bar called *a bloom*. This is subsequently reheated and drawn into plough shares, or other implements which may be wanted.

As the facility of the air bloomery would depend in a great measure upon a steady and uniform current of air, seasons would occur, and even insulated periods of the same operation, wherein the process would either not proceed at all, or with languor. When the high temperature was necessary to complete by a union of masses, the result of the previous deoxydation, a falling off in the current of air would not only retard but destroy the economy of the process. Under such circumstances, during summer, or in hot climates, the invention of bellows would be hailed as a powerful auxiliary to the air-bloomery. Their application, at first, would most probably be confined to that part of the operation necessary to produce the welding temperature, but experience and observation would soon lead to higher and more important advantages, which, in the end, though they must have been the result of infinite labour and perseverance, amply compensated for the additional expence of a bellows blower.

Blast-bloomery.

The æra of the *Blast-bloomery* must indeed have been the commencement of an important revolution in the art of iron-making. This will be better understood by contrasting the principles in the two operations respectively. In the *Air-bloomery*, the ore was, by means of the charcoal in contact deprived of its oxygen, and, as an inevitable consequence, aided by the increased temperature, passed into the state of soft or ductile iron. In the *Blast-bloomery*, not only was the ore deprived of its oxygen, but, by the higher and more uniform temperature occasioned by the use of bellows, a union took place between the iron of the ore and the charcoal, of the fuel. This combination would immediately produce fusibility; and crude, or cast-iron, or an imperfect steel, would first make its appearance in the early stages of the blast-bloomery. The soft and ductile preparation of iron, which resulted from the air-bloomery, would no longer appear, but become

Iron-Making.

mixed with a new and crude species of the metal, incapable of being hammered, and communicating to the more perfect product a deleterious quality,—the bellows would, in many instances, be laid aside, and their usefulness in the process denied, or at least doubted. Chance would discover to some smith, more intelligent than others, that, by frequent attempts in forging, the new metal was improved; he would soon observe, or discover, that this additional process might be considerably abridged, by directing the nose of the bellows upon the metallic regulus, before it was, in the first instance, removed from the furnace. Thus a new form of furnace would be suggested, having for its object the complete fusion of the ores, and the separation of the iron from them in a fluid state. Hence eventually resulted the blast-bloomery, in its most perfect and expeditious form, making in one day as much iron as an air-bloomery could in a week, and in a manner more economical, whether the measured result in metal from the ores or the abridgment of labour are considered.

The blast-bloomery of this country is still recollected by some very old men. Its form was either circular or square, its height from three to four feet. Previous to blowing, it was nearly filled with charcoal, then a charge of ore, over which was thrown a larger charge of charcoal. The blast was urged by means of bellows [illegible] constructed. The ores were thus rapidly heated, and deoxygenated in the upper part of the furnace [illegible] the ore descended and approached the blast [illegible] portion of the fuel, by the increased temper[illegible] united with the ore,—fusion ensued, and nearly [illegible] the metallic contents were precipitated on the bottom of the furnace. The nose of the bellows was [illegible] lined and directed upon [illegible] surface of the [illegible] mass,—combustion and [illegible] copious scor[illegible] ensued, which was removed from the furnace by repeated tapping. This operation was continued, and hastened by frequent stirring, till the remaining iron had, by an effectual decarbonization, passed into the state of soft or malleable iron. It was then broken into convenient masses, carried to the hammer, and formed, as in the bloomery, into blooms. In a more advanced and enlightened period the defects of the air-bloomery are many and striking. The cementation necessary to deoxydate the ore, previous to fusion, must have been, from the smallness of the furnace, partial and imperfect, and acquired at an immense sacrifice of fuel. The process was not, as in the modern blast-furnace, continuous; each charge, composed of a certain measure of charcoal and ore, was smelted, separated, and worked, before the furnace was filled for a renewed operation. When the charge of fuel happened to be in excess, which would sometimes be the case, the iron would imbibe an extra quantity of carbon, and be proportionally fusible; this would demand a prolonged action of the blast on the surface of the iron, and thus consume time in an unprofitable waste of the metal. The imperfection of the process may be pretty correctly estimated from the variety of slags, and the quantity of iron they contain. The Roman and Danes' cinders now found, and which were the current production of the blast-bloomery in remote ages, contain from 25 to [illegible] *per cent.* of iron, and have, in the last three hundred years, been extensively in use as ores, for the production of iron, in the *blast-furnace*.

Blast-furnace.

To the blast-bloomery, in the art of iron-making, succeeded a larger furnace, which is now known by the name of the *Blast-furnace*; and from the discovery of which, the *Foundery* and *Forge*, including the *Finery*, must have resulted. The vast advantages of this furnace arise from the continued action of reduction, a complete separation and recovery of all, or nearly all, the iron originally in the ore,—a greatly increased quantity in a given time—and a lessened consumption of fuel in the manufacture. Unlike the imperfect reguli of the bloomery, the metal of the new furnace was fluid, could be collected and remain so for many hours in the bottom of the furnace, and then be run into channels formed in sand,—but in this state, from the extra dose of carbon, it did not possess any property fitting it for the hammer, or for rendering it capable of being formed into a bloom, without subsequent operation. The effect produced in the blast-bloomery, by directing the bellows upon the surface of the separated iron, most likely suggested the idea of a separate furnace, in which a similar operation might be performed, without any connection with the previous smelting. The latent but unerring operations of chemical causes, accidentally associated with a larger furnace, and the favourable proportions of ore to fuel, would produce a fluid metal, which, along with the scoria flow[illegible] unexpectedly from the furnace, might thus first exhibit iron under a new form of existence. This would directly lead to experiments [illegible] the bloomery, with a view to obtain uniform and [illegible] results. In time it would be found out, that [illegible] to the height and capacity of the furnace increas[illegible] the fusibility of the iron, and produced it of sufficient fluidity to run from the furnace. This fact once ascertained, would open a new field of observation and experiment, and the dimensions of the furnace would only be limited by the sparing quantity of air, or blast, afforded by the imperfect bellows of the day. For a time this would be partially remedied by the use of a suspending medium in the furnace, since called *boshes*, but, in the end, the advantages of the large furnace would lead to an improved construction of bellows. The foot and hand blast bellows would give way to others moved by greater animal power, and these in their turn yield to larger bellows moved by the water-wheel. The power of a dozen bloomeries would be now concentrated in the new furnace,—convenience and locality to ore and fuel would be sacrificed to moving power, only to be obtained by the concurrence of water and fall.

In tracing the art through the lapse of ages (during which no memorial of facts has been preserved relative to the progress of iron-making), it seems evident, that its first general establishment, under the system of bloomeries, must have been on elevated situations, for the purpose of obtaining a powerful current of air. After the invention of bellows and the blast-bloomery, the art must have been carried into the plain,—every village and township where ore had

wood abounded would have its furnaces and smiths. The completion of the blast-furnace would once more remove the site of the manufacture, and the powerful blast of the new bellows, and the sturdy blows of the forge hammer, would, in the valley, supersede the more languid operations on the plain.

It is difficult to ascertain the period of the introduction of the blast-furnace into this country. Even in Dean Forest, the most ancient iron-making district, there exist no facts to show when it was there introduced, nor does tradition in any way assist us in the difficulty. In a publication of Dudley's in the reign of James I., the blast-furnace and other improved branches of the iron trade are there spoken of as *having* been extensive, "but now falling into decay, owing to the scarcity of wood." The art of the founder seems, too, at this period, to have been extensively practised, and judging from specimens still in preservation, considerable taste and skill in carving and relief must have been practised by the model makers of that period; and we know the fact of England's exporting, in the early part of Elizabeth's reign, a considerable quantity of such heavy ordnance as was then in demand. The civil commotions, excited by the long and disastrous contentions of the houses of York and Lancaster, were most unfavourable to the introduction or improvement of the arts or manufactures. It is more than probable, the use of the blast-furnace was first known in the time of Henry VII. Whether it was a native or an imported discovery does not now appear. On examination, the sites of the first class of blast-furnaces are found to have been placed on small streams near their source. The supply of water for moving the bellows was, of course, confined to the winter months, and, according to the copiousness or permanency of the stream, the furnace would be kept blowing four, six, or eight months. In an age when the division of labour was little understood and less practised, the disadvantages of this partial supply was not so great as they at first sight appear. The summer months were employed in procuring a supply of charcoal and ore for the winter consumption, and the same class of labourers passed from the furnace to the mines, or to the woods, and practised with equal facility their various callings.

From the period above alluded to, up to the present time, the only improvement to be traced in the charcoal blast-furnace is the increased size, and corresponding increased power of the blowing-machine. By the removal of the establishment from a solitary stream to a greater depth in the valley, where a larger portion of the drainage of the district had united, giving greater power and permanency of supply to the water-wheel, the weekly produce in iron has been increased from 10 to 25 and 30 tons; and a furnace, under the improved system, has been kept in blast for three years together. In the plates which accompany this article will be found drawings of furnaces used in the time of James and Charles I., and in our own time. The former are proportioned from the hearth of one of the King's furnaces, lately discovered in Dean Forest, and which furnace has not been at work since the commencement of the Civil Wars.

Although in tracing the progress of iron-making from the bloomery to the blast-furnace, it is seen, that, in all cases, the great object to be obtained was soft or malleable iron, yet we see the career of improvement, as if resting in the completion of a furnace, for the purpose of making an entirely new species of iron, possessing (except in weight) no properties in common with the tough iron of the bloomeries. But in this, as in every department of manufactures and the arts, the division of labour and of process have proved the true road to excellence. The division of iron-making, by whomsoever invented, into two distinct processes, must, at the time, have been marked by great and permanent effects. The manufacture of crude iron in the blast-furnace, and its subsequent malleabilization in the *refinery*, being operations not at all connected with each other, could be let alone, or carried forward, as best suited the views of the iron-maker. One man might smelt, and another purchase his iron and refine it. In place of obtaining from the bloomery one-fourth and one-third of malleable iron from the ore, the blast-furnace revived and returned, in a manner strikingly perfect, the whole iron of the ore, though in a state of crudeness or brittleness: though this was afterwards subjected to a loss of 25 *per cent.* in passing through the refinery, still, on the whole, it may be properly estimated, that, by the invention of the blast-furnace and the refinery, nearly double the quantity of iron, from the same weight of ores, was brought to market. The difference between the scoria of the bloomery and the blast-furnace would be so striking and manifest, that comparison would be succeeded by experiment. When the former were found to yield an abundant supply of iron by being smelted in the blast-furnace, a new species of property was created in the country. The spoil of the iron manufactures, from the time of the Romans downward, became at once, and for centuries, mines for the principal supply of the blast-furnace. Extensive proprietorships of Roman cinders (as they were called) were formed. Forests, covered with decayed oaks, were uprooted, and plains that had slept for ages under a great depth of soil, were unbarred to pour forth their newly created treasures. In Dean Forest, it is computed, that nearly twenty furnaces, for a period of upwards of 300 years, were supplied chiefly with the bloomery cinders as a substitute for iron ore. These were used in the proportion of five-eighths of the whole charge, the remainder being made up of the calcareous ores from the mines of the mountain lime, and a portion of lean argillaceous and silliceous ironstones, accompanying the coal measures.

Dudley says, that in his time there were in England 300 furnaces for the manufacture of pig-iron; that each had forty weeks supply of fuel, and made, while at work, fifteen tons weekly, making in all the incredible total of 180,000 tons annually; and this, too, at a time when he represents the trade as in a decaying state, from the failure of the supply of wood. Either his statement must have been un-

thinkingly exaggerated, or a great falling off in the manufacture must have taken place in the next hundred years; for we have it on good authority, that some time before pit-coal became the fuel of the blast-furnace, about the year 1740, the following quantities were respectively made in the English and Welsh iron-making counties:

	Furnaces.	Tons.
Brecon,	2	600
Glamorgan,	2	400
Carmarthen,	1	100
Cheshire,	3	1,700
Denbigh,	2	550
Derby,	4	800
Gloster,	6	2,850
Hereford,	3	1,350
Hampshire,	1	200
Kent,	4	400
Monmouth,	2	900
Nottingham,	1	200
Salop,	6	2,000
Stafford,	2	1,000
Worcester,	2	700
Sussex,	10	1,400
Warwick,	2	700
York,	6	1,400
	59	17,350

	Tons.	cwts.	qrs.
Annual average quantity for each furnace,	294	1	1
Weekly average quantity for each furnace,	5	13	0

Progress and present state of this Manufacture

Hitherto we have only spoken of the manufacture of iron in this country, as connected with the charcoal of wood as the basis of its operations. The gradually increasing population of the country had converted to other purposes a great portion of these woodlands that had formerly supplied fuel for the furnaces, and a period had arrived, when either a substitute must be found, or the manufacture of iron cease to be one of the staples of the kingdom. From Dudley, we learn, that James I. had granted many patents in divers parts of the kingdom for the manufacture of iron with pit-coal; that the attempts had uniformly failed, except in his own case, in 1619, when he succeeded to the extent of three tons weekly. The same gentleman, applying in 1668 to Charles II. for another patent for the same object, states, that he had succeeded at one time in making to the extent of seven tons of coke pig-iron weekly. But it was not till about the year 1750 that pit-coal became a general and profitable substitute for charcoal of wood in the blast-furnace. Subsequent experience shows the cause of this tardy advancement to have arisen from the want of a sufficiently powerful blowing apparatus. The introduction of the steam-engine, and the consequent increase of iron now made, soon pointed out the deficiency under which all former experiments had been made with pit-coal. The incombustibility of coke, compared with charcoal, requires a more copious and powerful discharge of air, in order that it may perform profitably the functions of smelting and carbonating the metal. As soon as this was made evident, it not only stimulated the manufacturer to erect appropriate blowing apparatus for his coke pig furnace, but it led to an immediate improvement in the blowing machinery of the charcoal furnaces, still supplied with wood, so that, in 1778, about forty years after the collation of the foregoing table, we find the state of the charcoal pig-iron manufacture to be as follows:

	Furnaces.	Tons.	Total.
Glocestershire,	4	650	2,600
Monmouthshire,	3	700	2,100
Glamorganshire,	3	600	1,800
Carmarthenshire,	1	400	400
Merionethshire,	1	400	400
Salop,	3	600	1,800
Derbyshire,	1	300	300
Yorkshire,	1	600	600
Westmoreland,	1	400	400
Cumberland,	1	300	300
Lancashire,	3	700	2,100
Sussex,	2	150	300
	24	making	13,100

	Tons.	cwts.	qrs.
Annual average produce from each furnace,	545	16	2
Do. of the former period (1740),	294	1	1
Annual increased produce in favour of the improved period,	251	15	1
Average weekly quantity produced in 1788,	10	9	3
Do. in former period, 1740,	5	13	0
Weekly increase in favour of the improvement,	4	16	3

But, during the same period, it is evident, that an annual diminution of the manufacture of charcoal pig-iron was experienced to the extent of 4250 tons, attributable to the decrease of wood, and consequently the use of coke pig-iron as a substitute. This deficiency was, however, amply compensated by the rapid increase of the manufacture of coke pig, as proved by the following statements:

Coke Pig Furnaces in England and Wales, in 1788.

	Furnaces.	Tons each.	Total.
Salop,	21	1100	23,100
Staffordshire,	6	750	4,500
Cheshire,	1	600	600
Derbyshire,	7	600	4,200
Yorkshire,	6	750	4,500
Cumberland,	1	700	700
Glamorganshire,	6	1100	6,600
Breconshire,	2	800	1,600
Stafford, about to blow	3	800	2,400
	53		48,200

Iron-Making.

			Tons.
Brought forward,			48,200
	Tons.	cwts.	
Average annual produce,	907	0	
Do. weekly do.	17	9	
Annual manufacture, at the same period, of charcoal iron, . . .			18,100

In the year 1788, there were erected, and blowing in Scotland, the following furnaces:

	Furnaces.	Tons.	
Goatfield, . . .	1	700	
Bunawe, . . .	1	700	
			1,400
Coke pig-furnaces, Carron,	4	1000	4,000
Wilsontown,	2	800	1,600
in 1788,			68,300
Do. in 1740,			17,350
Annual increase of pig-iron,			50,950

About the year 1796, Mr Pitt had it in contemplation to add to the revenue, by a tax upon coal at the pit. This, of course, led to a powerful opposition on the part of the manufacturing consumers, particularly in the iron trade. A committee was appointed, witnesses examined, facts collected, and the measure abandoned, as being unwise and impracticable. The following table, while it exhibits an abstract of the facts collected, shows the rapid progress of the iron trade in the course of the eight previous years:

Counties.	Number of Furnaces.	Excise Return of Iron made.	Supposed quantity by the Trade.	Actual Return.
		Tons.	Tons.	Tons.
Chester, .	2	4,710	2,200	1,958½
Cumberland, .	4	5,144	3,000	2,034
Derby, .	3	2,138	2,138	2,107
Glocestershire,	2	380	380	380
Herefordshire,	5	2,850	2,850	2,529
Yorkshire, .	22	21,984	21,987	17,947
Shropshire, .	23	68,129	43,360	32,969
Wales, .	28	45,994	42,606	35,485
Staffordshire,	14	15,820	15,256	13,210½
Sussex, .	1	172¾	173	173
	104	167,321¾	133,950	108,793

The return from Scotland exhibited a list of 17 furnaces, and an exact return of pig-iron manufactured, ... 16,086 tons.
Making a whole annual quantity of 124,879

Annual average produce from each furnace, which also includes the charcoal furnaces, . 1032
Annual average of 1788, including the charcoal furnaces, ... 800

Increase tons, . 232

In the six following years, there were built and building in England and Wales 40 additional furnaces, and in Scotland 7, the collective manufacture of which was computed at upwards of 170,000 tons annually. Nor did the trade, at this period, become stationary. Its unexampled increase and prosperity attracted the cupidity of the minister of the day; and it was reserved for a popular administration to fail in a financial speculation, which, if carried, was to cripple one of the main-springs of national prosperity. In 1806, a bill was brought into Parliament, having for its object a tax of L.2 a ton on all pig-iron made, and of placing the manufacture itself under the supervision of the excise. The bill itself was an anomaly in legislation, and though armed with powers and clauses in abundance, could not possibly have been acted upon. It was framed in utter ignorance of the nature or details of the manufacture, and contributed much by its absurdity to the failure of the cause it was intended to support. The union necessary to oppose the bill with effect produced a new series of facts, regarding the extent and progress of the iron trade in the kingdom, showing at that time its annual amount of product to be at least 250,000 tons. Since that period, the manufacture has gone on increasing; and, though subject to great depression in 1815 and 1816, has, during the last three years, resumed its former activity. The manufacture of pig-iron, in Wales only, may be computed at, tons *per annum*, 150,000
Shropshire and Staffordshire, . . 180,000
Yorkshire and Derbyshire, . . 50,000
Scotland and other places, . . 20,000

Total, 400,000

Process of Iron-Making.

Having thus narrated the progress and increase of the manufacture of pig-iron, we shall next describe, as concisely as possible, the economy and order of the process itself, both in the *charcoal* and *coke* blast-furnace, as at this time practised. Plate LXXXIX. fig. 1. represents a charcoal-furnace of the largest dimensions, blown by three iron cylinders, moved by a water wheel, and so constructed as to be blown at either side, or at the back through openings called twyers. The furnace is filled with charcoal, which is gradually ignited to the top, when a charge of ore is put in, with a proportion of flux, along with a certain number of baskets of charcoal. The furnace is from time to time opened below, and large bars of iron are introduced to serve as a temporary grate, through which the air may pass to the whole body of materials in the furnace. By the time the ore reaches the bottom, a considerable temperature has been excited, indicated by occasional fusions and scintillations. These are the general signals for introducing the blast. The furnace is shut up in front by means of a stone called the damstone, and space is left between this and the frontstone or tymp, which is filled with sand. The twyer is then opened and the blast introduced. Entire fusion commences. In a few hours the earthy matter of the ores accumulate in the state of glass, and are allowed to flow out at the opening in front, between the dam and tymp stone. In the meantime the iron, by its superior weight, falls to the bottom,

Iron-Making.

where it is allowed to collect for twelve or eighteen hours. The furnace is then *tapped* in an opening left on one side of the dam-stone, and the metal flows along a channel made in sand, called the *sow*, into the moulds prepared for it in the *pig-bed*. The charge introduced from time to time as the smelting and reduction take place, is called the burden, and this burden varies considerably, and at different works materially, owing to the quality and richness of the ore. For many years past charcoal iron has been made chiefly with the red hematitic ore of Lancashire, the uniform quality and richness of this "*mine*" rendering the operation of smelting a matter of greater certainty. Four large baskets, containing about ten bushels of charcoal, will smelt and carbonate the iron contained in four hundred weight of ore. With the necessary proportion of an argillaceous ironstone flux, this quantity will yield $2\frac{1}{4}$ hundred weight of iron. In the neighbourhood of Dean Forest, the calcareous ores of that district have been superseded by the use of Lancashire ore, except as a flux, for which purpose a lean carbonate of iron, much mixed with a sparry carbonate of lime, containing about 20 *per cent.* of iron, is used in the proportion of one-sixth to one-eighth of the ore. A charcoal furnace will consume from twenty-five to thirty thousand sacks in a year, each containing eleven to twelve bushels charcoal, the produce of at least one hundred and twenty acres of woodland. If the wood replaces itself fully in twenty years, then twenty-four hundred acres of land would be necessary to keep such a furnace at work.—Coke to manufacture the same quantity of iron is obtained from less than half an acre of the Staffordshire main coal.

The preparation of the coke blast furnace is similar to that practised with the charcoal blast-furnace, but its workings and burdens are infinitely more varied and complex than that of the latter, which, from the uniform quality of wood charcoal and Lancashire ore, experience has reduced to a certainty in every possible change and proportion arising from burden. In the coke furnace the case is widely different;—every new situation has, in the nature of the coal, and the quality of the ore, something novel and characteristic. The argillaceous ironstones generally used, are not very various in point of richness; few when roasted are under 35 *per cent.*, and equally few exceed 45 *per cent.*, and their composition generally unite silex, lime, and clay. As it is the convenient practice at most works to mix lean and rich ores together, so as to reach a common standard of 40 *per cent.*, there can be no material difference occasioned by the quantity of the iron used in the ore, the average produce of which may be correctly taken all over the kingdom at $37\frac{1}{2}$ *per cent.* It was long considered a fair burden if the coke *carried*, that is to say, smelted and carbonated the iron contained in an equal weight of the ore.—This is now materially exceeded in Wales and in Staffordshire. At Blanavon, in the former, the coke smelts double its weight of ores, and in that principality generally, it smelts 50 *per cent.* more ore than its own weight. The same thing takes place in Staffordshire and in Shropshire; but at some furnaces in Derbyshire and in Yorkshire, the coke does not smelt above two-thirds its weight of ore. Again, some coals in coking yield 65 to 70 *per cent.*, while others yield not more than 35. Hence a ton of iron is made at some furnaces under three tons of coal, and at others eight or nine tons are required for the same purpose. This great variety in the fuel renders general rules of little or no avail; a few simple principles, however, arising out of observation and experience, are understood and practised at all iron works.

The ironstones of this country, were they fused under the most favourable circumstances as to coke and blast, would not, without a mixture of lime or limestone, afford a perfect result,—the glass or scoria, from the excess of silex, would be languid and tough, the iron would separate imperfectly, and its quality be injured by combination with silicum, in the absence of lime. The latter having a greater affinity for silex than for iron, readily unites with the former, and leaves the iron to the full action of the carbon, and, like all mixtures, forms a more fusible compound than either separately. This mixture of the earthy matter of the ores is called cinder, scoria, or slag. In flowing it indicates, by its degree of heat, colour, and fluidity, with the most accurate precision, the quality of the iron accumulating in the furnace. Lime, however essential to a proper flow of cinder from the furnace, is not primarily the cause of change in the quality of the iron,—coke is the powerful vital agent,—on its properly proportioned quantity and its quality the whole result depends. In vain will it be to harmonise in quality and proportion the other materials, if the proper quantity of cokes be not present to reduce the charge into a proper state of division, and to carbonate the iron to such an extent as to pass the blast without oxydation. When the due proportion of lime and coke are present in the charge, the cinder flows from the furnace, sometimes transparent, opaque, white, glassy, variously mixed with fine tints of blue, and nearly free from oxyde of iron. The metal accompanying such a cinder is what is called carbonated, or grey pig-iron. If a portion of the coke is withdrawn from the charge which gave out such results, the cinder instantly changes to a brownish black, or entirely black colour,—the iron parts with its carbon, becomes white in the fracture, deteriorated in the quality, and the whole operations of the furnace become disordered.

Manufacture of Bar-Iron.

Having thus traced the general progress of the iron trade in Britain, commencing in a period of conjecture, and from beginnings the most limited and rude, to a state of most unexampled prosperity and national grandeur, during which the object of the iron-maker had changed from the production of malleable iron, in the first process, to that of crude iron, it is now necessary to retrace our steps, and pursue the subject as connected with the manufacture of malleable iron, or, as it is now called, bar iron. The advantages produced by the inflection of the bellows pipe in the blast-bloomery, as has already been noticed, most likely furnished the first idea of the refinery furnace, or the discovery might have been purely

accidental. A piece of cast iron, by some unforeseen, but possible circumstance, formed in and tapped from the bloomery, would, by its novelty, arouse curiosity and conjecture; and although, by simple heating, it would not yield to the impression of the hammer, yet, by a second fusion in a common smithy fire, new properties would be developed, and in the end, ductile iron would be obtained. It is likely that, for a long time, these occasional runnings from the bloomery would be considered as a species of waste, and from time to time worked up by the common smith, while the bloomery performed its more extensive functions. As the smith became more perfect in his art and manipulations, iron produced in this way would be possessed of superior strength and ductility, and would eventually obtain a preference in price and demand in the market. Thus a powerful inducement would be held out to the Bloomery proprietor, to increase, by direct experiment, the quantity of cast iron, and to devise a method by which it could be regularly made; nor would the manufacturer stop short till a furnace was constructed, continuous in its operations, and regular in its results, as to the production of cast or pig-iron. From that moment the refinery became a furnace of the utmost importance to the iron trade. The process here performed was bold and philosophical—nothing short of subjecting the most refractory of all metals to a violent combustion could free it from an admixture which, but for this, must have remained a perpetual bar to its ductility. The open cavity of the furnace being filled with charcoal, a fire, by means of the bellows pipe, more or less inclined, was soon created; the cast iron of the furnace was placed upon the burning fuel; in time it melted, and, dropping in detail, passed before the current of air issuing from the bellows, and, deprived of its carbon, sunk under the level of the nose-pipe, having lost its fluidity, and become sufficiently coalesced. Iron bars were then introduced; the clotted iron, broken into pieces, and brought a second or a third time up above the level of the blast, till a sufficient refinement had taken place to enable it to stand the blows of the forge hammer. In this operation of refinement, or burning out the carbon, the iron entered into a complete state of combustion, and a considerable portion of it was converted into scoria. The creation, management, and quantity of this scoria were matters essential to be understood, and properly practised, both as to the quality of the iron and the economy of the process.

The quantity of iron wasted in this operation depended upon the quality of the cast iron made use of. If the iron was highly carbonated, an extra tendency to fusibility existed; and a greater duration of exposure to the blast was necessary, to render the iron tough and ductile. From 25 to 35 *per cent.* of the whole iron introduced was, by this process, converted into a glass of iron, containing from 45 to 50 *per cent.* The operation itself, compared with after events, was simple and expeditious, and the quality of the iron good. It is by a similar process that the superior qualities of iron brought from Russia and Sweden are at this day manufactured; and the same mode is in general practice all over the Continent of Europe. In this country, the use of the finery continued as the only means by which iron could be profitably rendered malleable, until some time after the introduction of pit coal in its manufacture. When coke was first made use of in the blast-furnace, charcoal was still used in the common refinery, for the decarbonization of the iron to be made into bar iron; but it was found necessary to add another process to overcome the deterioration in the quality of the coke pig-iron. The lumps formed in the refinery were afterwards heated, and drawn out into blooms, and these again into bars, according to the quality of the iron wanted. As charcoal became scarce, the manufacturer ventured to add, in the refinery, a small portion of coke along with the charcoal, endeavouring, in the after part of the manipulations, to overcome the consequent deterioration of quality; but, as charcoal was at last entirely abandoned, and coke exclusively used, a considerable variation took place in the process. In place of forming the product of the refinery into lumps, which exposed very little surface when afterwards re-heated, the masses from the refinery were carried and put under a heavy hammer, of four or five tons weight, and beat out into a ragged sort of plate, called *stamp iron;* these were again broke, by mechanical force, into small pieces, and their qualities examined. Those pieces, little removed from the nature of pig-iron were called *raw*, and thrown aside to be refined. The perfect plates were built into piles of 50 lbs. to 70 lbs. weight; and each pile was placed upon a tile stone, or fire clay plate, or incased in a large rough sort of crucible, called a balling furnace pot. When a sufficient number of these were in readiness, a batch was introduced into a large furnace, heated with flame of pit-coal. When the temperature had been sufficiently raised to weld the parts together, each ball or pile was removed from the furnace in succession, by a pair of tongs, carried to the hammer, and formed into a bloom, being a short thick bar of iron. These blooms were re-heated in a fire, called the chaffery, and put under a lighter and more active hammer, where they were drawn into their destined shape.

A considerable waste of iron was in these various processes sustained, amounting to ten or twelve hundred weight for every ton of bars that were finished; but the difference of the price of fuel compensated for this additional loss; and the necessity of the case, from the diminution of wood, and increased demand, had become imperious. The manufacture of bar iron remained subject to the stamping process many years, and the quality of the iron so made was strong, and generally tough; but the tardy finish of the hammer, and the arrangement of the whole, was not calculated speedily to overcome quantity; and it was considered a respectable establishment that could turn out, in one week, twenty tons of bars fit for the market. Refineries could not be multiplied without an additional increase of blast; and this, in general, could not be done without additional steam-engines; and, in short, the manufacture had become apparently stationary, when the genius of Mr Cort furnished the ardent minds of his countrymen with a new and interesting field for enterprise. When Mr

Cort laid before the public his new plans, so inadequate was this country to the supply of its own demands, that it imported from Russia and Sweden the enormous quantity of 70,000 tons of bar-iron annually. The object of Mr Cort's processes was to convert into malleable iron, cast or pig-iron, by means of the flame of pit-coal in a common air furnace; and to form the result into bars by the use of *rollers* in place of *hammers*. He made many experiments, and expended large sums of money, in the progress of establishing his inventions; but, so long as the various qualities of pig-iron only were the subject of operation, the results in the *puddling* furnace (his invention) were uncertain, attended with waste, and unequal in quality. These obstacles were at last removed by the operations of the coke-refinery, already alluded to. In refining *grey* or fusible iron, it was in common practice to tap the fusion, immediately upon its being smelted, into a flat-box. This plate of iron being so far refined, was again thrown up on the fire, and passed a second time before the blast. If still too fine to come into "*nature*" it was again put on the fire, to complete its decarbonization. Some of these plates being taken to the puddling furnace, were observed, in working, to possess properties, both as to facility and quality, very superior to the best pig-iron. It then occurred that the finery ought to be employed, not as formerly, to refine the iron to the extent of malleabilization, but merely to decarbonize it to a certain extent, and to fit it more properly for the operation of *puddling*. This gave rise to the very extensive practice of "*running out*," which gives complete certainty to the puddling process. In this new refinery, or "*running out fire*," the various qualities of pig-iron are, by the skill of the workman, mixed and reduced to a common standard, which is now called finer's metal. By this means, the operations of the puddler are rendered certain, and he can reckon, within a few minutes, the continuation of his operation. In the commencement of this, as in all new things, much difficulty and waste of iron was sustained, and only a limited quantity overcome. The loss now, when the refinement is carried on in one fire to the extent of sixty to eighty tons a-week, is estimated not to exceed 2½ cwt. *per* ton, or 12½ *per cent.*

The puddling furnace, for which the refined metal is thus prepared, is, in its general form and appearance, not unlike a founder's air furnace. It is heated by means of pit-coal, on a grate; and, as may be seen in the drawing, has a chimney of considerable height, in which there is a damper, to regulate the degree of heat while puddling. A considerable portion of the space between the grates and the chimney is formed flat, and covered with a peculiar sand, possessing the properties, when heated, of becoming very hard and infusible. On this space is placed 3 or 3½ cwts. of finer's metal, and the flame allowed to pass over it with the full force of the furnace. In twenty minutes, the iron assumes a yellowish white colour, and marks of fusion appear on the angles of the pieces; the puddler then turns up new surfaces to the flame, and keeps breaking those which have reached a softened state. This he continues, at intervals, till the charge has subsided into a thick clotted sort of fusion. The furnace, at this period, is reduced to its lowest temperature; part of the furnace bars and fire are withdrawn, and the damper nearly shut; the puddler keeps stirring and moving the iron, backwards and forwards, which now begins to *ferment* and emit flashes of a bluish coloured flame (the carbon passing off in the state of carbonous oxyde). This operation is continued till these appearances pass off, and till the iron becomes less clotted, and begins, in the language of the workman, to *dry*. His exertions are redoubled, and soon the whole charge is reduced to the state of the finest saw-dust; it is now said to be *dry*, and so totally free from cohesion, that it may be moved about like as much sand. At this stage of the operation the grate bars are replaced; the fire repaired; the damper elevated; and the heat is in consequence increased, though gradually. The grains of iron become tipt with a snowy whiteness, resembling the welding of iron; they no longer repel each other, but begin to adhere in small masses; these increase in size as the temperature of the furnace is raised. When the charge begins to *work heavy*, the puddler selects a nucleus, and rolls it over and over upon the coalescing masses, till he has got it of the weight of 60 or 70 lbs.; he then places this on the flame side of the furnace, and anew he begins the operation of balling; repeating this till the whole charge is balled up. A heavy iron instrument, called a *Dolly*, is then introduced into the furnace, and with this the balls are in succession beat to give them more cohesion in rolling. When properly heated, they are removed by tongs from the furnace, and slid along iron plates to the rolling machine. Here the lumps or balls are each, in succession, passed through rollers, grooved diagonally, acquiring, as they pass, additional cohesion and firmness, and assuming the form of a bloom. This is then presented to another pair of rollers, with flat openings or grooves, and rolled into a bar of three or four inches in breadth, and from half an inch to three-fourths of an inch in thickness. The whole operation of rolling one of the balls is performed in a minute and a-half, and pleases, while it astonishes the observer, by the rapid change which is thus passed upon matter the most unshapely and refractory. The whole time taken up to complete a charge from the puddling furnace is only from two to two and a half hours; the loss sustained is from 10 to 12 *per cent.* One furnace will discharge five or six heats in twelve hours, and make in one week from ten to twelve tons of rough bars. A set of rollers, moved by a thirty horse power, will *rough down* in a week 200 tons of such iron, and keep twenty puddling furnaces at work, for which three or four refineries or *running out fires* will be necessary. The material thus produced is called *mill bars*, and require another operation before they are finished. For this purpose they are carried to a pair of large steel shears, and cut into regular lengths, proportionate to the bar ultimately intended to be made. These pieces are then piled on each other in reference to the required thickness, as the cutting was to the requisite lengths, and are introduced into the *reheating furnace*. A welding

heat, by the flame of pit coal, is here brought upon them in the space of twenty minutes; they are then, one by one, taken to another set of rollers, similar to the first, and in the diagonal grooves each pile is brought down to a certain size; they are then put into the *finishing rollers*, and rapidly formed into bars of the most perfect form, and most accurate dimensions. At one of the most perfect works in this or in any country, one bar of iron *per* minute is finished for hours in succession, and one set of rollers have finished, in twelve hours, twenty tons of bar iron of the most perfect form. This formerly would have been full work for a week in any large manufactory of iron.

Such has been the extension of the iron trade in this kingdom, mainly owing to the great facility presented by puddling and rolling. That the Cyfarthfa Iron Works alone manufacture annually double the quantity of pig and bar iron made in the whole kingdom between the years 1740 and 1750, and a quantity nearly equal to one half of the whole make as it stood so late as 1788. Several iron establishments, on a smaller scale, finish from 200 to 300 tons; and few there are which do not manufacture regularly 100 to 150 tons weekly. In South Wales alone, there are now made yearly upwards of 80,000 tons of bars; and, in the whole kingdom, besides, nearly 120,000 tons more, making in all 200,000 tons. One of the paramount advantages of the present system is the facility and cheapness of rolling. Iron of every possible size and form can now be obtained at the common price of bars. The labour of the smith, in forging and drawing, are now almost unknown, and the price of his work proportionally reduced.

It is painful to know that, incalculable as have been, and are likely to be, the national advantages derived from the puddling process, which has given England the command of the markets of the world, Mr Cort, the inventor, after expending an ample fortune in bringing the system to perfection, died, and a respectable family survives, without having received any public acknowledgment of his services, or compensation for his losses.

Iron Ores.

To comprehend fully the theory of the separation of iron from its ores, it is necessary to examine and operate upon them in a smaller scale than that of manufacture. Ores of iron are in general mixtures of oxydes of iron with certain earths, in every possible proportion, which, if fused alone, without any addition, would be formed into glasses more or less dense, according to the quantity of iron they contained, and in which no trace of metallic iron would be found to exist. The simple principle, therefore, in reduction, is to add a substance to which the oxygen will unite, in preference to remaining with the iron, and such other substances with which the earthy matters of the ore would combine, on the same principle. Carbonaceous matter is found essential to perform the former part of this operation; and opposing earths contrary to each other in their natures, are found sufficient for the latter. Thus, if a common ironstone of this country is fused alone, in a common clay crucible, the result is a black glass of iron. If charcoal be added in proportion to the quantity, the iron becomes separated. As the iron separates, it forms itself into a small spherule, under the glass. When charcoal is added in excess, that is, to the extent of one-fifth or one-seventh, the weight of the ore, three-fourths of the iron, will be found revived. The deficient produce remains in the glass, or unites to the superfluous charcoal, forming a magnetic carburet of iron. If there has been an excess of clay in the ore, the glass will be found black, opaque, and concave on the surface. If of silex, deep bottle green, with brownish-coloured cells, around the metallic button.

If this experiment is repeated with one-third or one-fourth the weight of the ore of lime, other circumstances being alike, the carburet of iron will disappear, the glass will be found dense, comparatively transparent, and the produce in iron greatly increased. If the same ore alone was put into a crucible, mixed with carbonaceous matter in its texture, or into one chiefly composed of black lead, fully one-half the produce of the ore would be revived. Or, if masses of the same ore were deoxydated by a prolonged cementation with charcoal, their subsequent fusion, *per se*, even in a common crucible, would yield five-eighths the whole iron contained in the ore; and, if fused in a black lead crucible, seven-eighths of the whole iron would be reduced to a metallic state.

When the first portions of iron are extracted from an ore, with a minor proportion of charcoal, the resulting globule is always in the state of soft or ductile iron; as the dose of carbon is increased, the iron subsequently passes through various states of steel and common crude iron; and, if properly conducted, into that of the richest carburet of iron. The quantity of reduction performed by the charcoal is various at various stages. In the first place, all the charcoal is employed to unite with the oxygen, and a certain additional quantity beyond this must be used, before iron is produced. After this the rate of reduction is increased, till more than one-half the iron is revived; it then falls off, upon the well-known ground that the last portions are always most difficult to extract. Much larger doses of charcoal, in proportion, are necessary; and it is essential to perfect separation that not only all the oxygen be removed from the ores, but that the resulting iron itself should take up a considerable portion of the carbon so added. The table subjoined will more clearly illustrate these hitherto unknown facts.

If a calcareous ore is subjected to fusion in a clay crucible, it will melt with facility, in proportion to the quantity of iron united with the lime, and form a black shining lustrous glass. If charcoal is added, the iron will separate; but if it is added in excess, the ore will become refractory, and not melt. The same ore, thrown into a black lead crucible, will sink down into a rough mass, without any separation of iron. If an argillaceous substance is added, fusion and a fine glass will ensue; and if a proper quantity of charcoal is present, the same will be transparent. If the argillaceous earth is diminished without any change in the charcoal, a pure white porcelain will be obtained over the iron, similar to, though much

Iron-Making.

more perfect than the cruddley or limy cinder of the blast-furnace.

The fusion of a siliceous ore of iron, *per se*, affords a highly polished shining glass of iron, the fracture of which frequently decomposes light. On the addition of charcoal, an imperfect ropy fusion is obtained. The siliceous matter is then resolved into a deep brown or yellowish glass, streaked with glass of iron, and the separated iron thrown about the crucible in a state of small globules of a silvery colour, which are generally understood to be an alloy of iron and the metal of silex. When the silex exists in small quantities, compared with the oxyde of iron, as is the case with the Lancashire and Cumberland ores, the whole of the iron may be revived with charcoal alone, and the earthy matter remain unfused, but in an agglutinated state.

Ores of iron are in themselves frequently united with such a mixture of earths, as to render, with the proper dose of carbon, the most transparent glasses, and iron of the most perfect quality. If the ores are rich, an inconveniency is sustained, by the metallic button being on its upper surface exposed without a covering of glass. This not only tends to decarbonate the iron, but, if in a state of ebullition, allows it to be projected against the sides and cover of the crucible, and makes the product difficult to ascertain.

The following is a table or abstract of a set of experiments, made with a common blast-furnace ironstone, in which experiments, lime, deprived of its carbonic acid, predominated as a flux, but to which other substances were added, to prove their effect in facilitating or retarding, with the same or different proportions of charcoal, the reduction of the metal from the ore. The ore itself had been previously assayed for carbureted cast iron, and yielded 46 *per cent.*

Table of the Reduction of Ironstones.

		Weight of the Mixture Grains.	Grs. of Iron obtained	Parts in 100.	Iron revived for each Grain of Charcoal	Grs. of Iron in the Glass	*Per* Centage of Iron in the Glass
1	Ironstone, Charcoal,	200 10	10	5	1.		
2	Ironstone, Charcoal,	200 20	51	25½	2.55		
3	Ironstone, Charcoal,	200 30	74	37	2.46		
4	Ironstone, Charcoal,	200 40	83	41½	2.075		
5	Ironstone, Charcoal, Lime,	200 10 100	¼	⅛		91¾	45.875
6	Ironstone, Charcoal, Lime,	200 20 100	31	15½	1.55	61.	30.5
7	Ironstone, Charcoal, Lime,	200 30 100	59	29½	1.96	33.	16.5
8	Ironstone, Charcoal, Lime,	200 40 100	89	44½	2.22	3.	1.5
9	Ironstone, Charcoal, Lime,	200 50 100	70	35	1.40	22.	11.
10	Ironstone, Charcoal, Lime,	200 50 150	79	39½	1.58	13.	6.5
11	Ironstone, Charcoal, Lime,	200 50 200	86	43	1.72	6.	3.
12	Ironstone, Charcoal, Lime,	200 55 200	80	40	1.45	12.	6.
13	Ironstone, Charcoal, Lime, Fluat,	200 40 100 25	84½	42¼	2.112	7½	3¾
14	Ironstone, Charcoal, Lime, Fluat,	200 40 100 50	79	39½	1.975	13.	6½
15	Ironstone, Charcoal, Lime, Fluat,	200 40 100 100	81	40½	2.025	11.	3½
16	Ironstone, Charcoal, Lime, Phosphat,	200 40 100 25	84	42	2.10	8.	4.
17	Ironstone, Charcoal, Lime, Phosphat,	200 40 100 50	82	41	2.05	10.	5.
18	Ironstone, Charcoal, Lime, Phosphat,	200 40 100 100	78	39	1.95	14	7.
19	Ironstone, Charcoal, Lime, Lynn sand,	200 40 100 25	85½	42¾	2.13	6½	3¼
20	Ironstone, Charcoal, Lime, Lynn sand,	200 40 100 50	80½	40¼	2.01	11½	5¾
21	Ironstone, Charcoal, Lime, Lynn sand,	200 40 100 100	81	40½	2.02	10½	5¼
22	Ironstone, Charcoal, Lime, Flint,	200 40 100 25	84	42	2.10	8.	4
23	Ironstone, Charcoal, Lime, Flint,	200 40 100 50	81½	40¾	2.03	10½	5¼

No.		Weight of the Mixture Grains.	Grs. of Iron obtained	Parts in 100.	Iron revived for each Grain of Charcoal	Grs. of Iron in the Glass.	*Per* Centage of Iron in the Glass.
24	Ironstone, .	200	76½	38¼	1.91	15½	7¾
	Charcoal, .	40					
	Lime, .	100					
	Flint, .	100					
25	Ironstone, .	200	83	41¼	2.07	9	4½
	Charcoal, .	40					
	Lime, .	100					
	Window-glass,	25					
26	Ironstone, .	200	80	40	2.	12	6
	Charcoal, .	40					
	Lime, .	100					
	Window-glass,	50					
27	Ironstone, .	200	78½	39¼	1.96	13½	6¾
	Charcoal, .	40					
	Lime, .	100					
	Window-glass,	100					
28	Ironstone, .	200	85	42½	2.12	7	3½
	Charcoal, .	40					
	Lime, .	100					
	Bottle-glass, .	25					
29	Ironstone, .	200	77	38½	1.92	15	7½
	Charcoal, .	40					
	Lime, .	100					
	Bottle-glass, .	50					
30	Ironstone, .	200	75	37½	1.87	17	8½
	Charcoal, .	40					
	Lime, .	100					
	Bottle-glass, .	100					
31	Ironstone, .	200	87	43½	2.17	5	2½
	Charcoal, .	40					
	Lime, .	100					
	Borax, .	25					
32	Ironstone, .	200	84	42	2.10	8	4
	Charcoal, .	40					
	Lime, .	100					
	Borax, .	50					
33	Ironstone, .	200	91	45½	2.27	1	½
	Charcoal, .	40					
	Lime, .	100					
	Borax, .	100					
34	Ironstone, .	200	86	43	2.15	6	3
	Charcoal, .	40					
	Lime, .	100					
	Muriat of Soda,	25					
35	Ironstone, .	200	81	40½	2.02	11	5½
	Charcoal, .	40					
	Lime, .	100					
	Muriat of Soda,	50					
36	Ironstone, .	200	79	39½	1.97	13	6½
	Charcoal, .	40					
	Lime, .	100					
	Muriat of Soda,	100					
37	Ironstone, .	200	77	58½	1.92	15	7½
	Charcoal, .	40					
	Lime, .	100					
	Tartar, .	25					
38	Ironstone, .	200	71	35½	1.77	21	10½
	Charcoal, .	40					
	Lime, .	100					
	Tartar, .	50					
39	Ironstone, .	200	65	32½	1.62	27	13½
	Charcoal, .	40					
	Lime, .	100					
	Tartar, .	100					

DESCRIPTION OF THE PLATES.

Plate LXXXVIII.

Fig. 1, Represents the section of an air-bloomery furnace, similar to that used by the Africans, as stated by Mr Park in his *Travels*.

Fig. 2. A horizontal section of the same furnace across the openings, used for the admission of air, and discharging the furnace.

Fig. 3, Represents a section of the old blast-bloomery, with its bellows and lifters, which was universally used for the manufacture of malleable iron before the invention of the blast-furnace, and the discovery of the manufacture of pig-iron.

Fig. 4, A ground plan of the same furnace, showing the bellows and blast pipes, and A, the opening which was regularly broken down at the end of each heat, to remove the bloom of iron from the bottom to the hammer. These [illegible] were worked in a very simple manner, without the assistance of levers, by a man alternately depressing the upper board of each, by merely treading thereon, which, in its turn, was again elevated by means of the lifter and counter weight. The stream of air, in this way, was prolonged with but little pause or interval.

Fig. 5, Is a section of the building, and interior of the charcoal blast-furnace, about the time of its first application for the purpose of making pig-iron. The remains of a furnace similarly constructed were accidentally discovered, in making an excavation, about eight years ago, in Dean Forest. This furnace, along with many others in ancient times, belonged to the Crown, were called *King's Furnaces*, and were probably used for the purposes of smelting, with the cord-wood of the forest, the King's share of the iron ore obtained from the mines.

From its situation on the margin of a small stream, and the remains of the water course, the bellows must have been worked by means of a small water wheel. The height of this furnace, from A to B, judging by the dimensions of the hearth and boshes, which were found entire, could not have exceeded 20 feet. The height of the hearth, from A to C, 4 feet, and the height of the boshes, from C to D, 2½ feet. The length of the hearth, from *e*, the back wall, to *f*, the front of the dam-stone, 4 feet.

G, G, The lining, constructed of thin beds of an infusible species of sandstone.

H, The hearth, composed of stronger beds of the same species of sandstone, called *land-stone.*

Fig. 6, Is a section at right angles of that part of Fig. 5, comprising the space from D to A, in which the letters correspond, showing the blowing orifice called the twyre, the twyre-arch, and the three cast iron bearers called "*sows*," for supporting the same.

Fig. 7, Is a horizontal section of the same furnace at D, the top of the boshes, Figs. 5 and 6, showing the quadrangular form of the interior, which was common to charcoal furnaces at that time, and in which the letters of reference also correspond.

This furnace was destroyed at the commencement of the civil commotions in the reign of Charles the First, and was never afterwards rebuilt.

Plate LXXXIX.

Fig. 1, Represents a section of one of the largest charcoal furnaces, such as are now in use, and which is also applicable to the making of coke pig-iron.

In this drawing the exterior building is omitted, and no more retained than is necessary to give a correct view of the interior of the furnace, and the arrangement of the blowing apparatus.

Fig. 2, Is a ground plan or horizontal section of the above furnace at the top of the twyre openings, exhibiting A, A, A, the twyre arches.

B, B, B, The blast pipes; the two dotted lines showing their communication with each other through the pillars of the furnace, and with the blowing machine.

C, The *fold*, fauld, or working-arch, by which the hearth is approached, and the operations of working, flowing the cinder, and tapping off the metal, are performed.

D, A longitudinal view of the hearth from the *back-wall* to the front of the dam stone.

E, The dam stone, about eighteen inches high, over which the *cinder* or scoria flows, and which closes up the front of the furnace, with the exception of the space at *f*, called the *tapping-hole*. This is opened from time to time to allow the metal to flow out. The letters in this plan correspond with those in the perpendicular section, Fig. 1.

Fig. 3, End view of the blowing machine, consisting of three cylinders, calculated to discharge the air both ways. The pistons are successively moved by means of three cast iron beams.

K, K, K, The three working beams (two of which only are seen), connected with a triple crank or lying shaft, I, I, I. To this crank-shaft is attached a small pinion wheel G, which is worked by the large spur wheel H, placed on the shaft of the water wheel.

Fig. 4, Is a ground plan of the former, showing the crank-shaft I. The tops of three blowing cylinders L, L, L, with the valve openings N, N, N, the main valve boxes and blast pipes M, M, M. The letters of reference correspond with those of Fig. 3.

Fig. 5, A view of a refinery furnace, or running-out-fire, with its blowing apparatus.

O, The general appearance of the furnace.

P, The front plate of the hearth, with the tapping holes.

Q, The cistern into which the water of the tue-irons empties itself.

R, A reservoir for the supply of the tue-irons with cold water.

S, The tue-iron pipe, which conveys a constant stream of water to prevent the tue-irons from burning. The tue-irons for this purpose being made double, leaving a hollow space all round for the water.

T, The nose-pipe, inflected for the purpose of discharging, when melted, a current of air upon the surface of the metal, to produce refinement or decarbonization.

U, The blast box, containing the valve for regulating the air.

V, The blowing cylinder.

W, The blast pipes for conveying the air into the inverted water regulating cistern X.

Y, Y, The space for the ascent and descent of the water, for restoring the equilibrium, giving smoothness to the motion of the engine, and rendering the current of air more equable throughout.

Fig. 6, Represents a ground plan of the blowing machinery, and two running-out fires.

Z, Z, The hearths in which the iron is melted and refined.

t, t, t, t, The water tue-irons, two of which are necessary for each fire. The other letters of this plan correspond with those of Fig. 5.

Fig. 7, An enlarged section of the water tue-iron, with its pipes of supply and discharge, *s* and *r*.

Fig. 8, End view of the above tue-iron, showing the two holes for receiving the pipes *s* and *r*, and the size of the blowing orifice at the smaller end. It is the same with that referred to under the letter *t*, in Figs. 5 and 6.

Plate XC.

Fig. 1, A section of a coke pig-iron furnace, with its twyres and twyre-arches, similar to what are at this present time used in South Wales, where upwards of one hundred tons of pig-iron have been produced weekly from one furnace. The extreme height of this surface from the bottom at A, to the filling place at B, is 50 feet. The height of the hearth, from A to C, 8½ feet; from C to the top of the boshes at D, 8½ feet. The diameter of the hearth, from A to C, increases from 3 feet to 3½ feet. The extreme width at the top of the boshes D, 18 feet. The diameter of the charging place, B, 6 feet.

E, E, E, E, The lining composed of a double circle of fire bricks, about 15 inches long, each, with a space for an intermediate packing of sand.

F, F, The hearth, constructed of large blocks of breccia or plum-pudding stone, from over the mountain limestone measures.

G, G, The twyres or openings, by which the blast is discharged into the furnace.

	Cubic Feet.
Contents of this furnace, . .	5015
Ditto, the large charcoal ditto, .	1017
Ditto, small ditto, . .	428

Fig. 2, A view of a double power steam-engine for the purpose of blowing furnaces, the steam cy-

linder of which is 60 inches diameter, the blowing cylinder 100 inches diameter; length of the stroke, 9 feet; travels 12 double or 24 single strokes *per* minute.

	Cubic Feet.
Capacity of the blowing cylinder,	$486\frac{1}{2}$
Quantity of air discharged at the rate of 24 cylinders *per* minute, .	11760

Density of the blast, 3 pounds *per* square inch.

This engine is capable of blowing four furnaces at the rate of 3000 cubic feet of air *per* minute for each, and making from 250 to 280 tons of pig-iron weekly.

A, The steam cylinder.

B, The blowing cylinder.

C, The cold water cistern, with its ends taken off to show the air-pump *p*, and condensing cylinder *s*.

D, The lever wall for supporting the cast-iron beam.

E, The working beam and parallel motions to which the steam and blowing piston rods are attached.

F, The steam cylinder pedestal of ashlar work.

G, The pedestal of the blowing cylinder, serving also to load the air receiver, *x*, beneath.

H, H, Spaces for the water to ascend when displaced by the compressed air within the inverted cistern, *x*. The difference of level, between the surface of the water in the interior and exterior of this cistern, when the engine is at work, will always be in the ratio of the density of the blast. In this instance, the surface of the outside water will be nearly seven feet higher than that of the water within the regulating cistern.

I, The branch blast pipe for communicating with the water regulator.

Fig. 3, A ground plan of the steam cylinder, pedestal, cold water cistern, air pump, condenser, and lever wall, the letters of which correspond with those in the elevation.

Fig. 4, Is a ground plan of the blowing cylinder, blast-pipes, pedestal, and water regulator.

K, K, K, K, Represent the openings or valve spaces in the top of the blowing cylinder, for admitting the air during the descent of the piston. A similar number of these openings with valves affixed, are placed in the bottom of the cylinder for admitting the air during the ascent of the piston.

L, The blast box, containing the upper main valve for preventing the return of the air during the descending stroke. A similar box, containing the lower main valve, may be seen at L, in the elevation (Fig. 3), for preventing the return of the air, during the ascending stroke. The other letters in this figure correspond to those in the elevation.

Plate XCI.

Fig. 1, A ground-plan of a mill for rolling various sorts of iron.

A, The crank by which motion is communicated to the machine, when steam is the moving power.

B, The large spur-wheel, the teeth of which work into those of

C, The pinion wheel, to the axis of which the roller pinions are coupled.

D, The fly-wheel, of cast iron, 24 feet in diameter.

E, The small spur-wheel for imparting motion to

F, F, F, Three pinions, and their respective shafts, to which the rollers, or cutters, are occasionally coupled.

G, G, G, G, The main cills, which are heavy masses of cast iron.

H, The puddling or roughing-rolls for compressing into regular form the balls of iron from puddling furnace.

I, Rollers for finishing flat bars.

K, Rollers for forming square bars of iron.

L, Pinion and rollers for hoops or plate iron.

M, Pinion and cutters for slitting rod iron.

N, N, N, N, N, N, Roller and cutter cills made of cast iron.

O, O, Eccentric wheels for working the cutting sheers. P. (Fig. 2.)

Fig. 2, An elevation of that part of Fig. 1, comprising the crank-shaft, spur wheel, fly wheel, and cutting sheers, P; the other letters correspond to those in the ground plan.

Fig. 3, An elevation of that part of Fig. 1, including the small spur wheel, three adjoining pinions, fly wheel, and main cill. The letters correspond with those of the plan. (Fig. 1.)

Fig. 5, Rollers for sheet, plate, or hoop iron.

Fig. 13, An enlarged view of one of the roller housing frames, with the rollers, plummer blocks, brasses, and adjusting screw, corresponding to *t, t, t, t*, in Figs. 1 and 5, and Fig. 4, Plate XCII.

Fig. 15. Ground plan of a water wheel bar iron forge, with two hammers and anvils.

A, The water wheel and shaft.

B, Forge hammer, with a cast iron helve and supports, lifted by projecting pieces of cast iron, on the end of the water wheel shaft, called *cams*.

C, A forge hammer, with a wooden helve, lifted by similar means. Only one of the hammers can be worked at a time, and the latter only when the motion is reversed, and in cases where, instead of the water wheel, a steam-engine is the moving power.

Fig. 17, An elevation of the forge (Fig. 15), showing the water wheel, cam-ring, cams, standard, hammers, anvils, anvil blocks, and framing.

F, F, The anvil blocks and anvils.

G, The standard for supporting the end of the water wheel shaft.

H, The spring beam corresponding to Fig. 16, Plate XCII.

I, The cam-ring and cams. The other letters in this figure correspond to those on the ground plan.

Plate XCII.

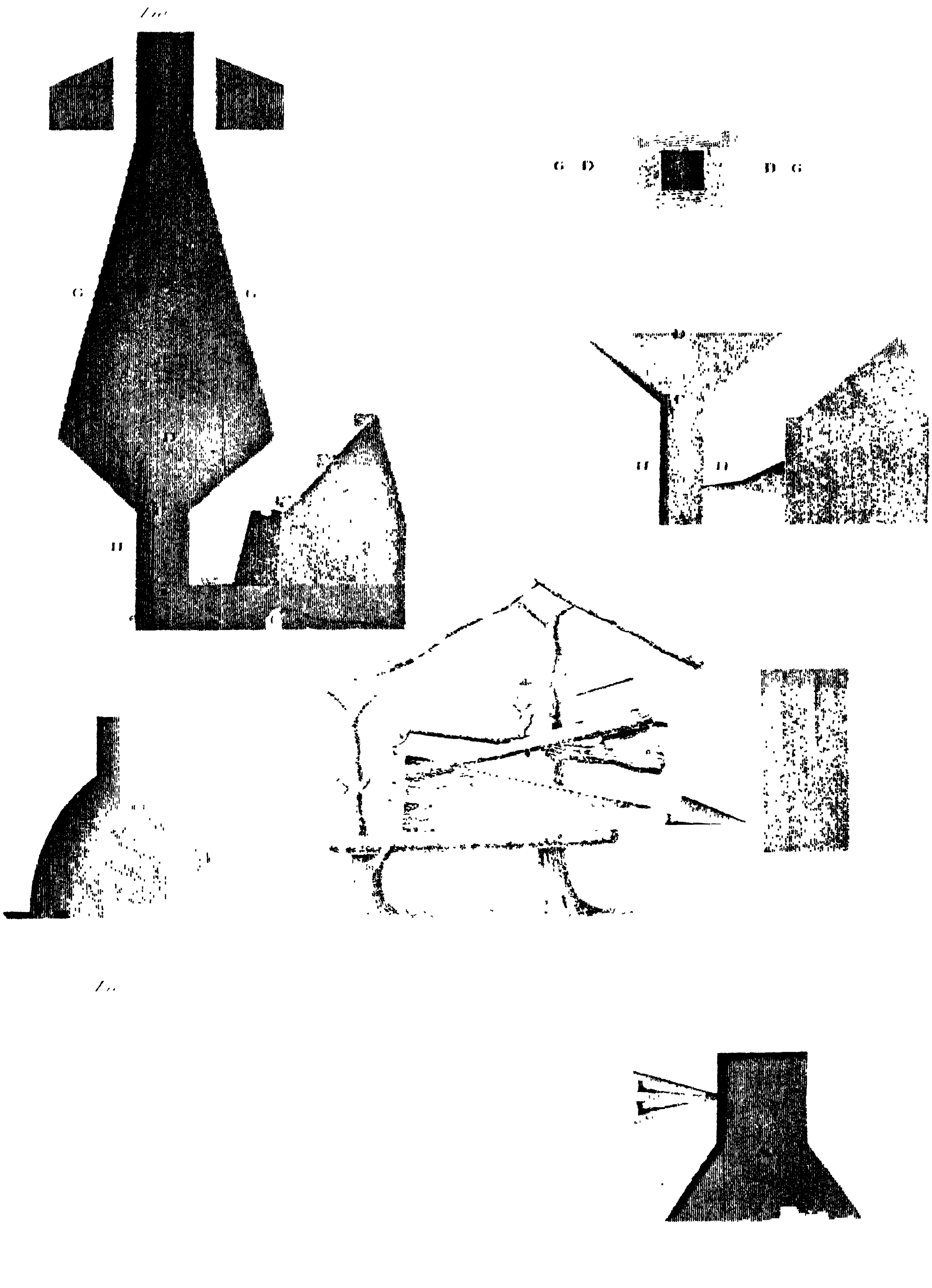
Fig. 4, An elevation of three different sets of rollers, with their pinions, housings, cills, and underground buildings.

a, Rollers for the extension of square bars.

b, Rollers for forming and finishing flat bars.

c, Rollers for making round or bolt iron.

Fig. 6, An enlarged view of the rollers, pillar-bed, and pillars, with their screws, which are broken off for the conveniency of the plate. This figure is the same as that of *r, r*, Fig. 1, in Plate XCI. and of *r, r*, in the centre rollers, Fig. 4, Plate XCII.


G D
D G
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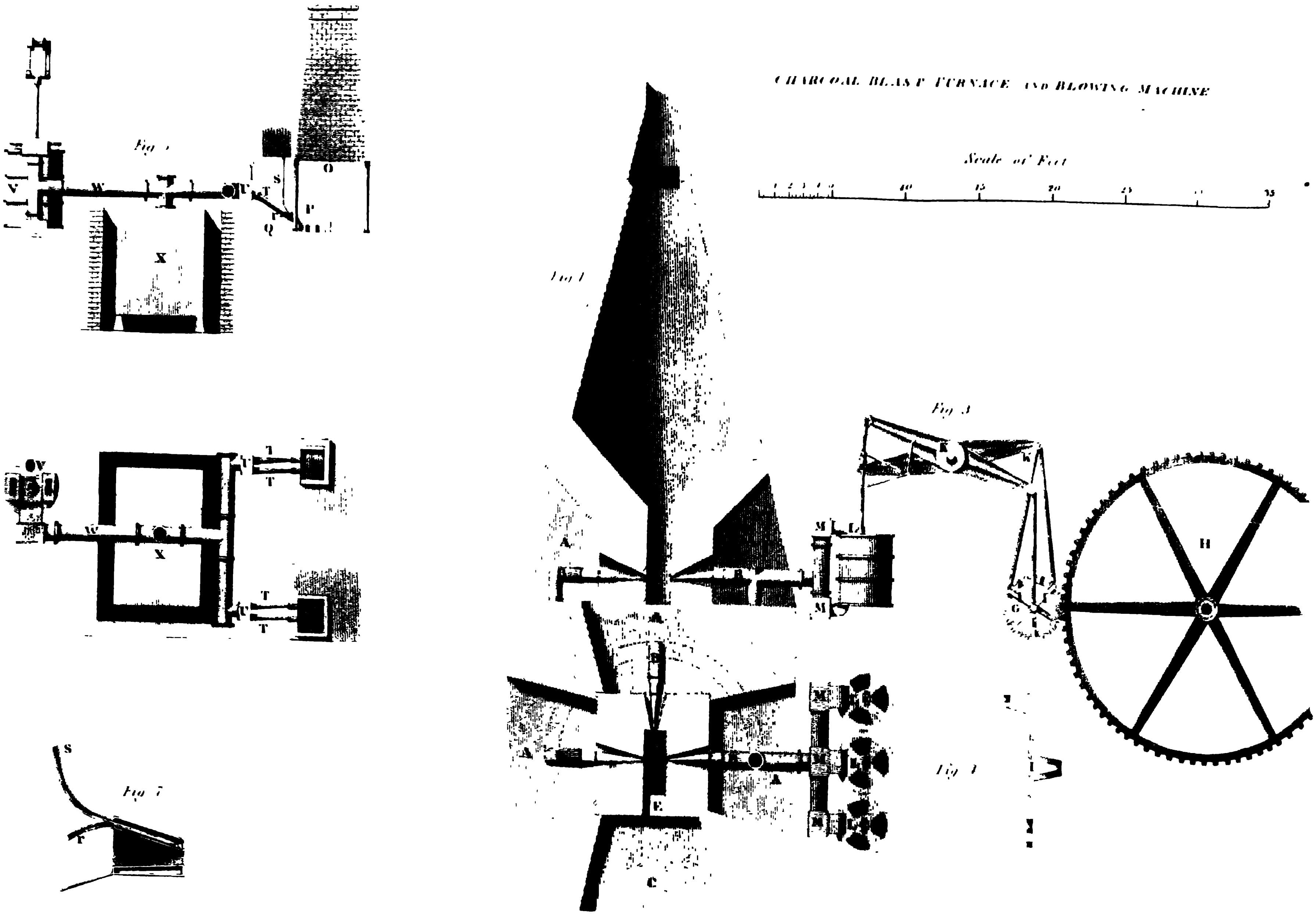
IRON

PLATE LXXIX.

REFINERY OR RUNNING OUT FIRE

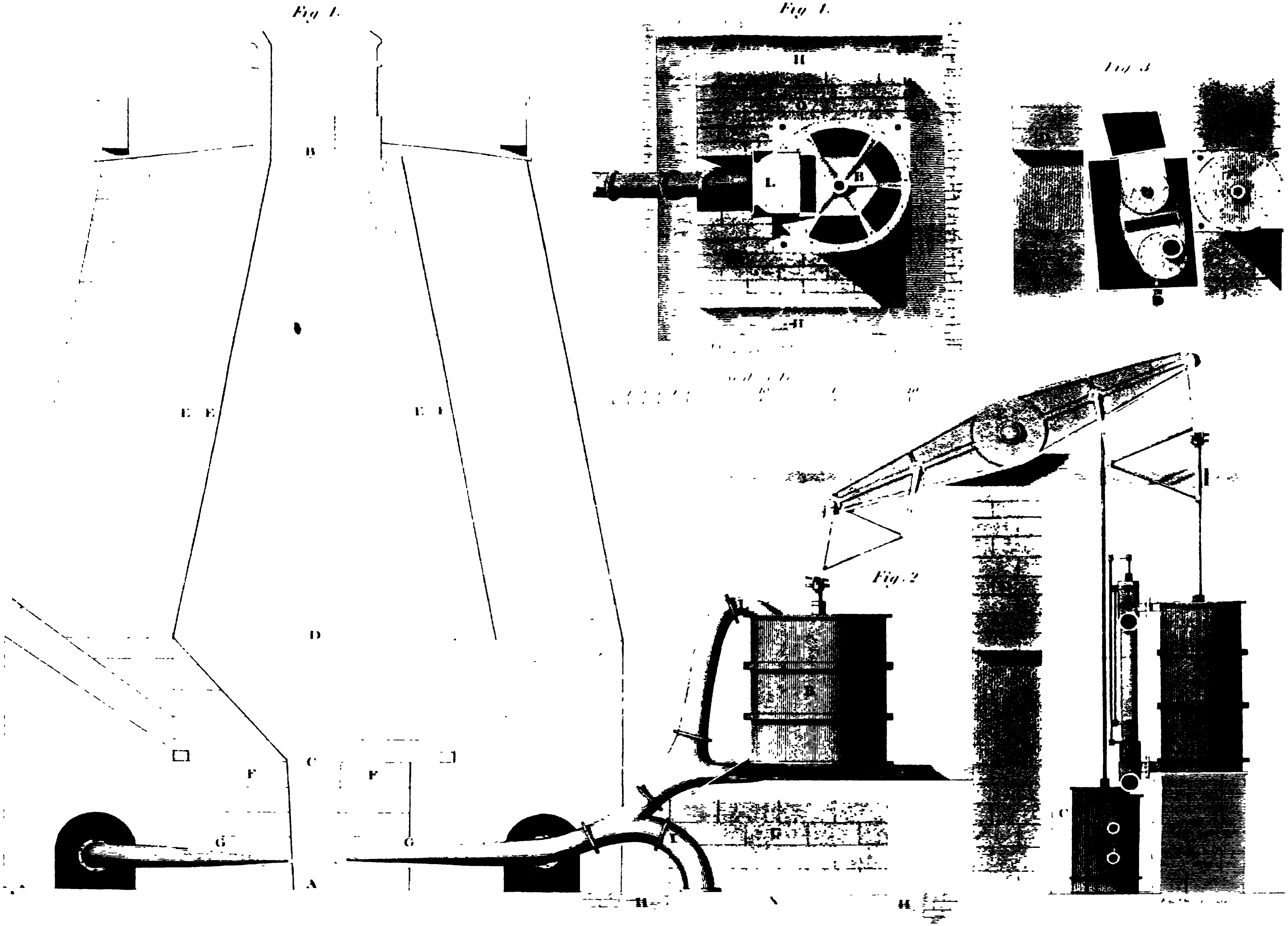
CHARCOAL BLAST FURNACE AND BLOWING MACHINE



IRON

PLATE XC

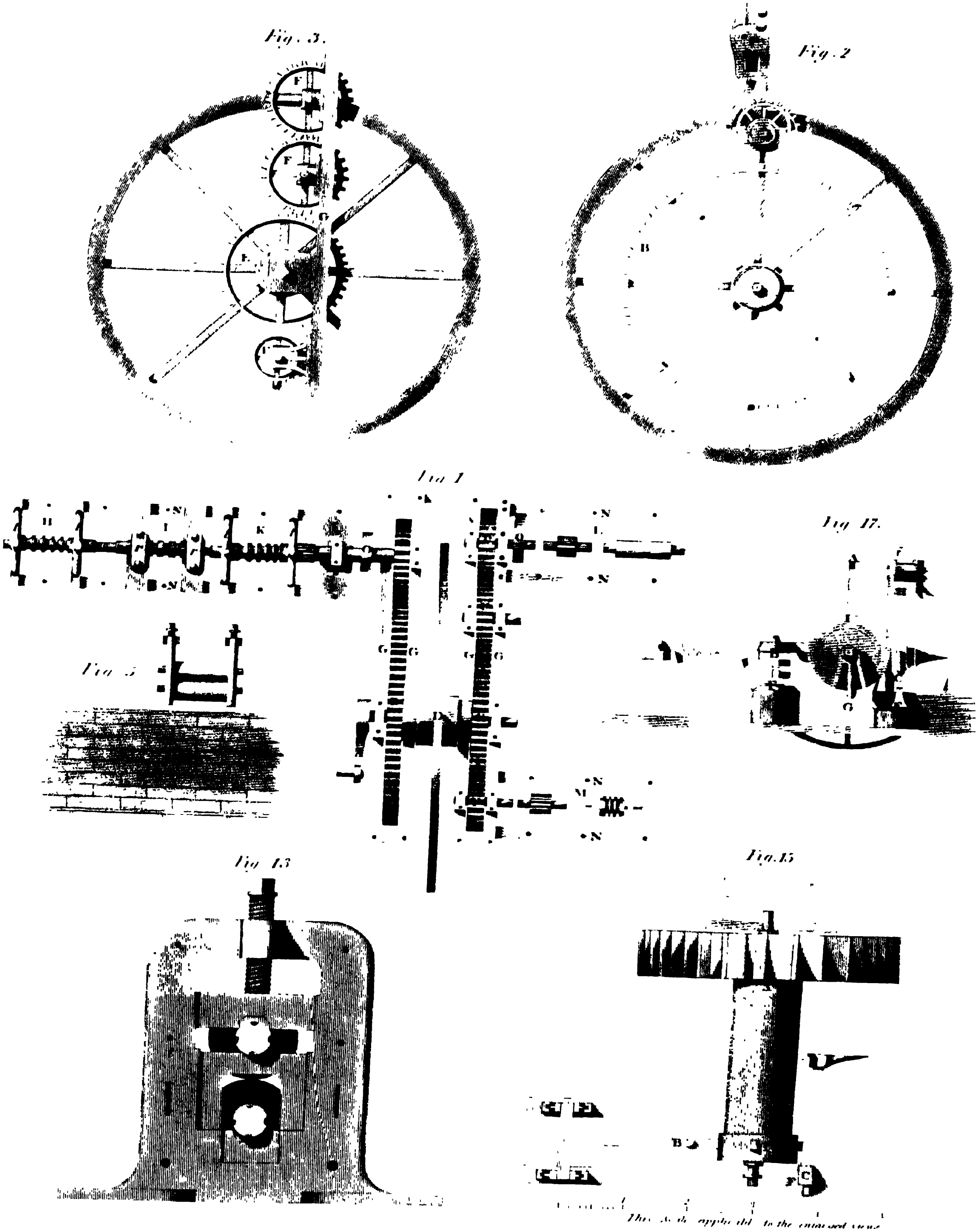
COKE BLAST FURNACE AND BLOWING ENGINE



IRON

PLATE XCI

IRON ROLLING MILL FORGE AND PUDDLING FURNACES.



This Scale applicable to the enlarged views

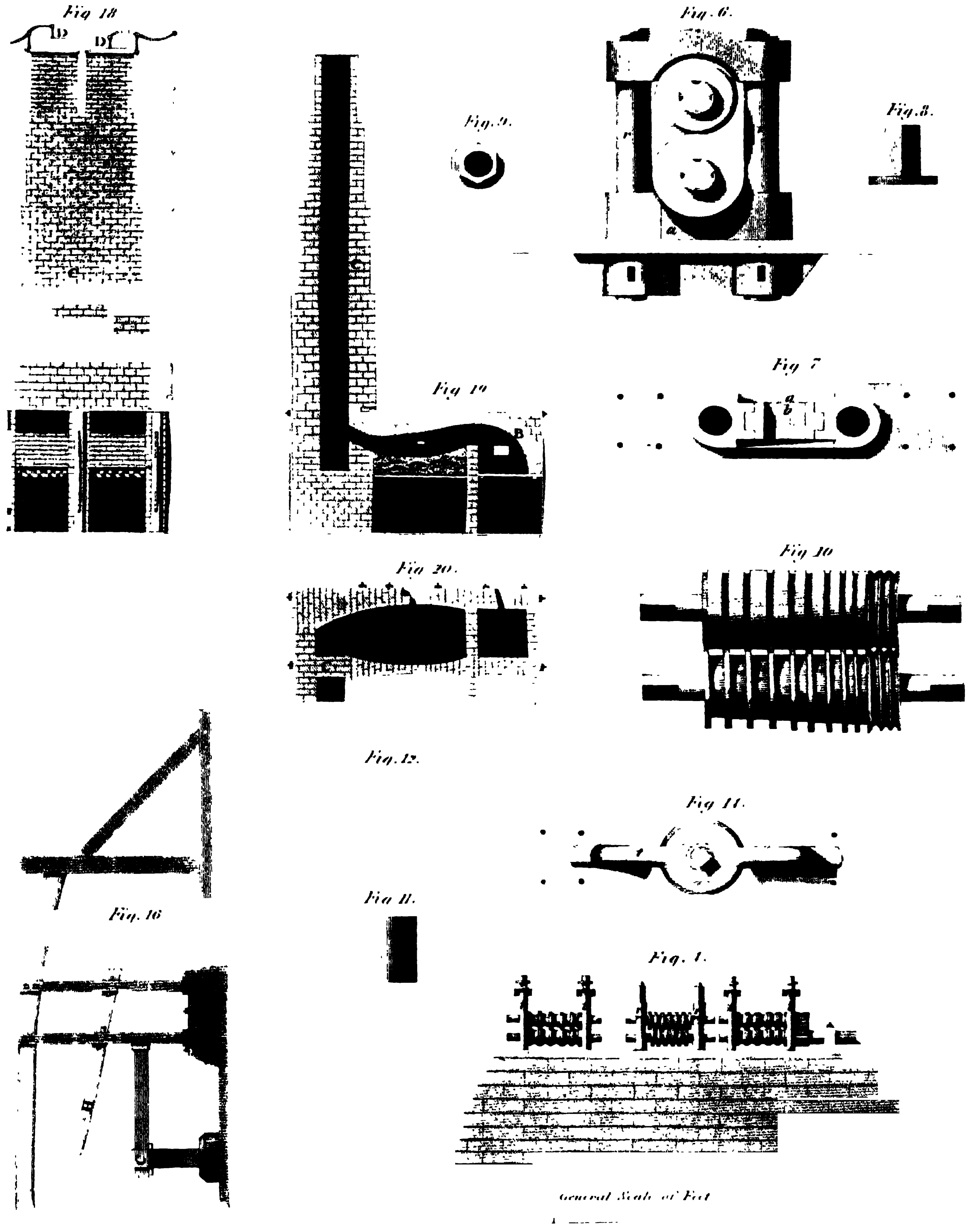


Fig. 18
D
D
Fig. 9.
Fig. 6.
Fig. 8.
Fig. 19
B
Fig. 7
a
b
Fig. 20.
Fig. 10
Fig. 12.
Fig. 14.
Fig. 16
H
Fig. 11.
Fig. 1.
General Scale of Feet

Fig. 7, Plan of the above pillar-bed, showing the block *a*, and the brass *b*.

Fig. 8, Screw box which fits on the top of the pillars.

Fig. 9, Plan of the above screw box.

Fig. 10, An enlarged view of a pair of bar iron finishing rollers, showing the grooves for holding the coupling boxes.

Fig. 11, Coupling box, for connecting the rollers with the pinion shafts and with each other.

Fig. 12, Plan of the coupling box.

Fig. 14, Plan of the housing. Fig. 13, Plate XCI.

Fig. 16, Represents a view of the wooden helved hammer, spring beam, or rabbit, anvil, anvil block, foundation, and framing.

Fig. 18, Represents an elevation of two puddling furnaces and chimney in the direction of the grates.

A, A, The grates with the bars.

B, B, The arched end of the furnaces at the greatest distance from the chimney.

C, The chimney.

D, D, The dampers.

Fig. 19, A section of a puddling furnace and its chimney, showing the mode of binding the brick work with iron plates.

E, The cavity of the furnace, and the charging door, by which the metal is introduced to be puddled.

F, The grate which sustains the fire, and the opening by which the coal is introduced.

G, The bottom of sand resting upon an iron plate. The other letters correspond to those of Fig. 15.

Fig. 20, A horizontal section of the puddling furnace, showing the grate and puddling cavity with the respective doors. The letters corresponding to those of Figs. 18 and 19.

(K. K. K.)

ITALY.

The History of *Italy*, down to the year 1789, is given under the article Italy, in the *Encyclopædia;* and the events of importance, which have subsequently occurred, will be found under our articles Austria and France. In the present article, we shall confine our attention to the general features of the country, its agriculture and manufactures, and the political situation and manners of its inhabitants. The limits within which we are necessarily confined oblige us to exclude all descriptions of the cities, antiquities, and monuments of the fine arts, in this interesting country. The recent *Travels* of Forsyth, Eustace, Williams, and Matthews, are so copious on these topics, as to leave hardly any thing to be added to what they have collected; and, without attempting to abridge what they have written, we shall endeavour to give some information on subjects which have not fallen so particularly under their consideration.

CHAP. I.

Divisions—Rivers, Lakes, Mountains.—Population.—Climate.—Malaria.—Classes into which Society is divided.—Manufactures.

Italy comprises four great divisions; in each of which the face of Nature, in the mode of cultivation, and the condition of the people, is very different from what is in the others.

Divisions. The *first* of these embraces the vast plain which lies between the Alps and the Appenines; and extends from Coni on the west, to the Adriatic on the east. It is bounded on the south by the Appenines, which, branching off from the maritime Alps, run in a south-easterly direction to the neighbourhood of Lorretto; and on the north by the chain of the Alps which presents a continued face of precipices from sea to sea. This rich and beautiful plain is, with the exception of a few inconsiderable hills, a perfect level; insomuch, that for 200 miles there is not a single ascent to be met with. Towards its western end, in the plain of Piedmont, the soil is light and sandy; but it becomes richer as you proceed to the eastward, and from Lodi to Ferrara is composed of the finest black mould. It is watered by numberless streams, which descend from the adjacent mountains, and roll their tributary waters to the Po; and this supply of water, joined to the unrivalled fertility of the soil, renders this district the richest, in point of agricultural produce, that exists in Europe. An admirable system of cultivation has long been established in this fertile plain; and three successive crops annually reward the labours of the husbandman. (Chateauvieux, 12; Young, 2. *passim.*)

The *second* extends over all the declivities of the Appenines, from the frontiers of Provence to the southern extremity of Calabria. This immense region comprises above half of the whole superficial extent of Italy, and maintains a very great proportion of its inhabitants. It everywhere consists of swelling hills, rapid descents, and narrow vallies, and yields spontaneously the choicest fruits. The olive, the vine, the fig tree, the pomegranate, the sweet chesnut, and all the fruits of northern climates, flourish in the utmost luxuriance on the sunny slopes of Tuscany and the Roman States; while, in Naples and Calabria, in addition to these, are to be found the orange tree, the citron, the palm, and the fruits of tropical regions. The higher parts of these mountains are covered by magnificent forests of sweet chesnuts, which yield subsistence to a numerous population, at the height of many thousand feet above the sea; while, at the summit, pastures are to be found, similar to those of the Cheviot Hills in Scotland.

The *third* region comprises the plains which lie between the Appenines and the Mediterranean, and extends from the neighbourhood of Pisa to the mountains of Terracino. This district, once covered by a numerous population, and cultivated in the most careful manner, is now almost a desert. It is the region of insalubrious air; and no means have yet been devised by which it is possible to enable the human race to flourish under its pestilential influence. After leaving the highest state of civilization in Florence or Rome, the traveller is astonish-

Italy.

ed to find himself in the midst of vast plains, over which numerous flocks of cattle wander at large, under the care of shepherds mounted on horseback, and armed after the fashion of the steppes of Tartary. This division includes under it all the plains which lie between the Appenines and the Mediterranean in the Neapolitan territory, among which the Maremma of Pestum is most conspicuous; and nothing but the vast population of Naples prevents its celebrated Campagna from relapsing into the same desolate state.

The *fourth* great division comprehends the plains which lie to the eastward of the Appenines, in the kingdom of Naples, and is bounded by the Adriatic Sea on the one side, and the irregular line of the mountains on the other. It is in some places from 50 to 100 miles broad, and in others the mountains approach the sea shore. The country is flat, or rises into extensive downs, and is cultivated in large farms where it is under agricultural management; but a great proportion is devoted entirely to pasturage. Immense forests of olive are to be met with in this remote district, and the hills are covered with vines, and oranges, and other fruits, with corn growing under them. (Williams's *Travels*, II. 137, 138.)

Rivers.

The principal rivers are, the Po, the Arno, and the Tiber. The first of these drains the whole plain of Lombardy, and receives in its course all the torrents which descend from the southern side of the Alps and the northern front of the Appenines. The quantities of sand and gravel which these torrents bring down during the autumnal and winter rains, renders them extremely destructive to the soil in their vicinity, which is generally overwhelmed, often for the distance of miles on each side, by a load of stone and gravel torn from the higher parts of the mountains. To guard against the devastations of the Po, in its progress towards the Adriatic large mounds have been constructed on each side of the river, in the Lombard and Venetian territories; and these mounds have been progressively raised as the channel of the river was filled by the *debris* of the mountains from which it is supplied. The consequence has been, that not only this great stream, but also the Tessino, the Brenta, the Tagliamento, and the Adige, in many places, flow in a channel greatly elevated above the adjacent country; and the same may be observed of many other torrents in their course from the Appenines to the ocean. (Young, I.; Chateauvieux, 80.) The *Lagunæ* of Venice are formed by the sand and earth which these great rivers have brought down to the Adriatic; and which has accumulated at their mouth, from the combined influences of the stream and tide. (Daru, *Hist. de Venise*, I. 10, 11.) The Arno runs in a north-westerly direction from the centre of the Appenines towards Pisa, and receives, in its course, all the streams which descend from the western declivity of the Appenines. Its waters are gathered with religious care by the industrious peasantry of Tuscany, and by an infinite number of small canals, made to fertilize almost every field in the delightful valley, to which it has given its name. (Chateauvieux, 81.) The Tiber rises in the recesses of the mountains in the north of the ecclesiastical state, and, swelled in its course by the torrent which is precipitated over the rocks of Terni, and that which adorns the classical scene of Tivoli, winds through the deserts of the Campagna, and flows, in a majestic current, through the walls of Rome. In the autumnal months it is liable to frequent and sudden inundations from the torrents which fall in the mountains; and, even in summer, its waters are so discoloured, as to justify the ancients in calling it *flavum Tiberim*. The most remarkable rivers in the Neapolitan territory are the Garigliono and the Sele; the former of which falls into the sea, near Mola di Gæta, while the latter descends from the wooded mountains behind Eboli, and glides through the deserted Maremmæ of Pestum.

Lakes.

There are few countries which can boast of a greater number of Lakes than Italy. Those of Maggiore, Como, and Lugano, are assembled at the foot of the mountains immediately to the north of Milan; and combine, perhaps, a greater variety of beauty than any other lake scenery in Europe. They are surrounded by the lower Alps, whose summits bear the character of the chain to which they belong, while their sides are clothed with the luxuriant woods, and rich vegetation, which indicate the warmth of an Italian sun. Innumerable villages, each adorned with a spire, and composed of white cottages, peep through the verdant foliage, with which the steep declivities of the mountains are covered, or are perched on the side of rocks seemingly inaccessible to human approach. On these delightful banks, the olive, the vine, and the sweet chesnut, flourish in the utmost luxuriance; while, in the warmer aspects, the orange and the citron are nursed by the inhabitants, as a mark of the mildness of their climate. The Lago di Gardo is a great expanse of water, 40 miles in length, the lower extremity of which descends into the plain of Lombardy, while its northern end is lost in the recesses of the Alps. Its banks exhibit the same singular combination of extensive woods with innumerable spires and white villages, which characterize Maggiore and Como; but its expanse is too great to admit of the romantic beauties which have rendered these lakes so celebrated. The lake of Varese is an oval sheet of water, surrounded by the sunny hills, which mark the melting of the Alps into the plains, and on which the choicest fruits, and the richest crops, rewards the industry of the husbandman. In the centre of Italy, the lake of Thrasymene is interesting, not merely from the memorable battle fought there, but from the smiling aspect of its wooded and peopled banks; while that of Bolsena presents a totally different character, being shut in by dark forests of pine and oak.

Mountains.

The only range of mountains which properly and exclusively belongs to Italy is the Appenines; and they extend over more than half of the country. Their height is very various; in the vicinity of Genoa they rise to about 4500 feet; above Pontrimoli, on the borders of Tuscany and Lombardy, they reach 5500 or 6000 feet, and the great ridge which stretches from Bologna by Valombrosa to the south-east, rises in some places to between 6000 and 7000.

Italy.

They are not, in general, very rocky; at least, it is only in their higher eminences that this character appears. Their lower parts everywhere almost are covered with fruit trees, under the shade of which, in the southern exposures, crops of grain are brought to maturity, Higher up, the sweet chesnut covers the ascent, and supports an immense population, at an elevation above the sea, where no food for man could be procured in our climate. The pine, the beech, and the fir, occupy those higher regions, in which are Valombrosa, Lavernia, and Camaldoli; and at the summits of all, the open dry pastures furnish subsistence to numerous flocks. (Forsyth, 92; Chateauvieux, 57.) This great capability of the Appenines to yield food for the use of man, is the cause of the extraordinary populousness of its slopes. In the remotest recesses, the traveller discovers villages and towns: and on the face of mountains, where the eye, at a distance, can discern nothing but wood, he finds, on a nearer approach, every spot of ground carefully cultivated. The villages and towns are commonly situate on the summits of eminences, and frequently surrounded by walls and towers; a practice which began in the turbulent periods of the Italian republics, and has been since continued from the dread of *Malaria* in the bottom of the valleys. It adds greatly to the picturesque effect of the mountain scenery, and gives it a character altogether peculiar. In the Tuscan states, the lower ranges of the Appenines have been the object of the utmost care, and of an almost inconceivable expenditure of capital. They are regularly cut in terraces, and, whenever an opportunity occurs, water is brought from the adjoining rivers, and disseminated in little covered canals to every field, so that the whole valley is, as it were, covered with a network of small streams, which convey their freshness all around. The olives and figs which flourish in this delightful region are foreign to the Tuscan soil; there is not a tree there which is the spontaneous production of nature; they are all planted and pruned by the hand of man.

Climate.

The Climate of Italy is known to all the world. Poets and travellers, from the earliest times, have united in celebrating its enchanting air, and its cloudless sky. During the spring these praises are, indeed, deserved; but in summer and autumn, the excessive heats render it disagreeable to venture out in the forenoon, and foreigners insensibly fall into the Italian custom of taking exercise only in the dusk of the evening. Even the peasants yield to this universal propensity, and for a few hours at noon repose from their labours. The thermometer, in summer, often rises at Florence and Rome to 90° of Fahrenheit; at Naples, it is sometimes as high as 96°. From 75° to 85° is the usual heat of Italy in summer; from 40° to 70° in winter. Frost and snow rarely occur in the plains, though always on the mountains. Delightful as it is, however, this climate is not without its disadvantages. In the close of the year immense torrents of rain fall, often with little interruption for weeks together; and the unhealthiness of the atmosphere, almost every where to the south of the Appenines, induces such of the inhabitants of the plains as have the means, to migrate, during the months of summer and autumn, to higher situations. Yet, with all this, it may safely be affirmed, that the clear air and sky of Italy is a source of enjoyment, which, to those who have not witnessed it, can hardly be imagined. Independently of its other influences, it gives an indescribable charm to the productions of the earth. Innumerable plants of aromatic fragrance fill the air with their sweetness, and seem to flourish best in those sterile situations, where nature can produce no food for the use of man. Their fragrance in the spring extends to a great distance from the rocks on which they grow; and the traveller, as he sails in the night from La Spezia to Genoa, inhales the perfumed air, wafted from the shore by the nightly breeze of these warm climates. The activity of the Italians in former times, proves that their climate is quite consistent with the most energetic and industrious habits of life; while there can be no doubt, that the delicious air which they breathe, and the beautiful objects which are continually before their eyes, have had a material effect in producing that taste in the fine arts, by which they are distinguished from every other people of modern Europe.

Malaria.

There is one peculiarity of the Italian climate which is well deserving of notice, the *Malaria*, which, during the autumnal months, renders the greater part of the plains so dangerous to the inhabitants and to foreigners. This pestilential air is little known in the western parts of the plain of Lombardy, but it is felt in the vicinity of the rice grounds of Pavia, as well as at the northern extremity of the Lake of Como. The neighbourhood of Ferrara, and the country which lies between it and Bologna, is, owing to the malaria, one of the most unhealthy of Italy; Venice experiences its fatal effects in the autumnal months, and the shores of the Gulf of Commacchio is hardly habitable during the heats of summer from the same cause. But it is principally to the south of the Appenines that this dreadful evil predominates. The whole plain of Tuscany, between the mountains and the sea, is neglected, from the insalubrity of the atmosphere. In the Roman States, the *Campagna* of Rome, and the Pontine Marshes, are absolutely deserted; and the ravages of the malaria are so much dreaded in the city itself, that all the wealthy inhabitants migrate during the autumnal months to Frescata and Albano, whose elevated situations place them above its reach. The *Campagna* of Naples, notwithstanding its thick woods and rich cultivation, is not exempt from it; and the shores of Pazzuoli and Baiae are in some places so dangerous, as to occasion certain death to those who, during the warm weather, are exposed to the influence of the night air. No army has ever yet besieged Naples in summer without having its ranks thinned by the *malaria* fever. The French army, which capitulated to Charles V. in 1528, was reduced from 28,000 to 4000 in the course of a few days, by being encamped before they were embarked on the shores of Baiae. The beautiful plain in which Pæstum is situate exhibits a deserted waste from the same cause, and the inhabitants who dwell among its ruins, or on the

Italy.

melancholy shores of the Sele, prove by their wan and emaciated appearance that habit has no tendency to enable the human frame to bear its effects. Universally, indeed, to the south of Florence, the plains and low grounds are more or less subject to malaria, and it is chiefly to this cause that the common practice of building villages on the summits of the mountains, by which the picturesque appearance of the country is so much enhanced, is to be ascribed.

The fevers which this pestilential air produces, commence in July, and continue till the heavy rains of September and October have precipitated the noxious vapours, and restored the salubrity of the atmosphere. During the intervening months it is in the highest degree dangerous to be exposed to the night air; and the marshes should not be traversed even during the day, without taking every possible precaution. So strongly are the inhabitants of the country impressed with this idea, that the shepherds who tend the flocks in the Campagna, resort to Rome during the night, and seek under its walls and houses an asylum from the danger which they would run in the open country. The best advice that can be given to travellers is, to avoid the dangerous regions during the autumn months; but if they are obliged to visit them at that season, they should never travel at night, and take care to close the windows of their rooms from sunset till they rise next morning. It is advisable to live rather fully when in the unhealthy districts; and if the *Maremma* are to be crossed, bark and Port wine, and a few glasses of *Lachrymae Christi*, should be taken before setting out in the morning. Intoxication, however, of the slightest kind, is cautiously to be avoided, as exposure to the night air when under its influence is almost certain death. By observing these precautions, the dangers of the climate may be effectually guarded against, and the traveller may visit the environs of Rome and Naples even during the unhealthy season, without running any considerable risk. If he is seized with the malady, bark and Port wine, as in the English ague, are generally employed.

Population. The Population of Italy has been ascertained by a very accurate census, taken under the authority of the French Government, during the sway of Bonaparte; and it shows an aggregate of 16,419,000 souls, or 1237 inhabitants to every square league,—a population more dense than that of France, or the British Isles. When it is recollected how large a proportion of the country is rendered uninhabitable by the bad air, this shows how dense must be the numbers in those districts where man is able to exist. The country is 700 miles long, from the mountains of Aosta to the extremity of Calabria; in Lombardy, it is 350 miles broad; in the central parts, about 140; and at the extremity of Calabria, only 75.

This population is distributed as follows:

	Square Miles.	Inhabitants.
I. Kingdom of the Two Sicilies.		
Naples,	31,000	4,963,000
Sicily, with the lesser isles,	12,600	1,635,000
Total,	43,600	6,618,000
II. Kingdom of Sardinia.		
1. Piedmont, including Nice,	7,900	1,750,000
2. Duchy of Montserrat,	900	186,000
3. Part of Duchy of Milan,	3,300	556,000
4. Territory of Genoa,	2,300	532,000
5. Savoy,	3,800	450,000
6. Sardinia,	9,200	520,000
Total,	27,400	3,994,000
III. Kingdom of Lombardy and Venice.		
1. Province of Milan,	8,310	2,032,000
2. Province of Venice,	9,950	1,982,000
Total,	18,920	4,014,000
IV. Ecclesiastical State,	14,500	2,346,000
V. Tuscany, including Elba,	8,500	1,180,000
VI. Duchy of Parma, Placentia, and Guastalla,	2,280	377,000
VII. States of Modena.		
1. States of Modena, Mirandola, and Reggio,	1,740	332,000
2. Duchy of Massa and Carrara,	320	38,000
Total,	2,060	370,000
VIII. Duchy of Lucca,	420	138,000
IX. Republic of St. Marino,	40	7,000
Grand total of Italian States,	117,090	19,044,000
Deduct Sicily, Sardinia, and Savoy,	25,600	2,625,000
Italy Proper,	91,490	16,419,000

which is 180 to the square mile.

Great Towns. The following is a table of the great towns in the Italian States:

	Inhabitants.
Kingdom of the Two Sicilies.	
Naples,	330,000
Palermo in Sicily,	130,000
Messina in do.	70,000
Calama in do.	60,000
Bari,	18,000
Kingdom of Sardinia,	
Turin,	65,000
Genoa,	76,000
Cagliari,	35,000
Alessandria,	30,000
Nice,	19,000
Casali,	16,000
Chamberry,	12,000
Kingdom of Lombardy and Venice.	
Milan,	130,000
Venice,	116,000
Verona,	42,000
Brescia,	34,000
Padua,	31,000
Mantua,	23,000

	Inhabitants.
Cremona,	23,000
Bergamo,	20,000
Ecclesiastical State.	
Rome,	134,000
Bologna,	64,400
Ferrara,	24,000
Ancona,	18,000
Duchy of Tuscany.	
Florence,	75,000
Leghorn,	50,000
Sienna,	24,000
Pisa,	17,000
States of Modena.	
Modena,	20,000
Reggio,	13,000
Massa,	9,800
Carrara,	8,500
Duchy of Parma.	
Parma,	28,500
Placentia,	15,000
Lucca,	17,000
St Marino,	6,000

The comparative density of the population in these different states is as follows:

	Inhabitants.
Kingdom of Naples,	160 to the square mile.
Kingdom of Sardinia,	146
Do of Lombardy and Venice,	211
Ecclesiastical State,	168
Tuscany,	139
Duchy of Parma,	121
States of Modena,	190
Duchy of Massa,	118
Duchy of Lucca,	328
Republic of St Marino,	175

Population at Different Periods.

That the great towns of Italy were much more populous at former periods than they now are cannot be doubted. Mr Gibbon states the population of Rome, in 1765, at 161,899. (Gibbon's *Works*, XII. 429.) Chateauvieux estimates its population, in 1791, at 166,000. The extraordinary defalcation since this period, being 32,000 in twenty years, is owing partly to the increase of the malaria; partly to those causes, which, during the war, destroyed the sources of its prosperity. Since the peace, it is understood that its population has considerably increased, principally in consequence of the concourse of travellers, and the resumed residence of the Papal government.

Florence, which now can number only 75,000 souls, contained, at the close of the fifteenth century, 150,000, and in 1496, ventured to measure strength with Charles VIII. at the head of all the feudal power of France. (Sismondi, XII. 168.) At that period, and for nearly a century before, it had engrossed the commerce of the south of Europe, and its private merchants numbered all the kings of Europe among their debtors. (Villani, 824.) Pisa, at a still earlier period, contained 140,000 inhabitants, whereas its population is now reduced to 17,000. (Hallam's *Middle Ages*, I. 454.) When the rival fleets of Genoa and Pisa fought at La Meloria, in 1284, each bore as many sailors as manned the English and French fleets at Trafalgar, and 11,000 of the vanquished party were carried off to the Genoese prisons. (Sismondi, IV. 22.) Venice, at one period, numbered 43,000 sailors in her fleet, whereas the whole population capable of bearing arms does not now amount to nearly that number. The immense extent of the buildings in most of the towns of Tuscany, as Sienna, Pistoia, &c. which are hardly inhabited, prove how great the numbers of the inhabitants were in former, compared to what they are in modern times. The latter of these cities formerly contained 40,000 souls;—at present it hardly possesses 8000. (Chateauvieux, 82.)

Notwithstanding this great diminution of the population of the Italian *towns*, there is reason to believe, not only that the inhabitants of Italy, upon *the whole*, have gone on progressively increasing during all this period, but that they are at this moment more numerous than they were at any former period of its history, not excepting the most flourishing periods of the Roman empire. (*Ibid.* 300.) The population of Tuscany was calculated, about the year 1780, at 1,000,000: it is now considerably above that number. (Paoletti, 58.) In Friuli, the population, in 1581, was 196,541; and 1755 it contained 342,158 inhabitants. In the district of Padua there were, in 1760, 240,336 souls; in 1781, 288,300. In short, if many parts of Italy are not now so populous as they were during the flourishing periods of her republics, it is more than probable that the deficiency is compensated by the great agricultural population in other districts; or at least that population has advanced rapidly during the last hundred years, to fill the blanks occasioned by the misfortunes of the sixteenth century.

The cause of this remarkable decrease among the inhabitants of the great towns, and increase in the agricultural population, is to be found in the entire destruction of commercial and manufacturing industry, which followed the destruction of the republics, and the establishment of the Spanish dominion over the whole country, in the early part of the sixteenth century. (Sismondi, XVI. 158.) The wealth of all the commercial cities was, in consequence, turned to the purchase of land, the only remaining employment in which it could find any profit; and so universal was the transference, that, before the close of the sixteenth century, the commercial was every where converted into a landed aristocracy.

The great quantity of capital which was thus directed from commercial industry to the purchase of land, contributed in some degree to produce that minute division of estates which distinguishes Tuscany, and is observable even in the plains of Lombardy. (Chateauvieux, 84, 293.) So large a proportion of her people has, since the loss of Italian independence, been directed to rural pursuits, that it is now calculated at thirteen out of the seventeen millions of which her population consists.

Different Classes of the People.

The Italian people may be divided into five classes. 1. The proprietors of land, or *Possidenti*, as they are called. 2. The merchants. 3. The

manufacturers and artificers. 4. The professional classes. 5. The cultivators of the soil.

The *first* of these classes, that of proprietors of land, is extremely numerous, but by no means wealthy. The extreme subdivision of land, which, in all the states of Italy except Naples, and the *Maremme* of Rome and Tuscany, has been established from time immemorial, prevents the estate of any one proprietor from being very considerable. Three or four thousand a-year is reckoned a very great income. But though estates are not large, they are numerous; and it is to this cause that the multiplicity of the Italian cities is to be ascribed; for the proprietors universally live in towns. Their estates are every where let to the peasantry, on condition of paying half the produce to the landlord; and this produce is disposed of by the proprietors, as the consignments of a West Indian estate are by an English planter. (Chateauvieux, 344. Young, II.) The lower stories of the palaces are filled with vast warehouses of wine, oil, and grain, the produce of the estates; and hence has arisen the singular custom of each great house at Florence, and in some other places, having an aperture in the wall beside the door, through which any quantity of wine, however inconsiderable, is sold to the inhabitants. These proprietors, in consequence, do not consider their estates as capitals yielding fixed rents, but as a property, the income of which varies according to the seasons, and the state of the markets. Their sole employment is looking after their estates, which they visit occasionally, and with the tenantry of which they are generally on the best terms. (*Ibid.*) After harvest the steward visits the farm to make a division of the crop. The farmer engages to convey the landlord's share to the city, where, as already mentioned, it is deposited in the large magazines appropriated to that purpose in the palace.

The variable state of the markets renders it necessary for the landholders to live in the most economical manner, in order to avoid incurring debt in unfavourable seasons. So small is the quantity of capital in the country, that if a proprietor is obliged to borrow, he is ruined in a few years. (*Ibid.* 345.) They never engage in any profession or line of industry to better their condition. If they can make their income cover their expenditure it is all they desire; and it is absolutely necessary that they do not permit any excess in the latter. Hence has arisen that remarkable disposition to economy which characterizes the Italian nobles, and that limited expenditure which has such important effects on the other classes of society. Their palaces are often wretchedly furnished, and their domestic consumption very moderate. In one particular only do they manifest a disposition to extravagance, namely, in their equipages. Every proprietor, however limited his income, conceives it absolutely necessary that he should keep a carriage and a pair of horses, with which he parades on the *Corso* in the evening before going to the opera. Hence in every town, however small, there is a *Corso*, and hence that extraordinary display of carriages and servants, which strikes a stranger so much at Florence and Milan, and seems so entirely disproportioned to the wealth of these cities in other respects.

Italy.

Merchants.

The *second* class, or that of merchants, is very inconsiderable. Great as was the commercial wealth and activity of the Republics in former times, hardly any trace of this prosperous state of things now remains. Ever since the subjugation of Italy by the Spaniards, its commercial and manufacturing industry has declined; the necessary consequence of the insecurity of property, and the ruinous monopolies with which the exchange of commodities was everywhere shackled. (Sismondi, XVI. 237.) The trade which the Italians now carry on consists chiefly of the local or home trade of the country itself. This home trade, however, is considerable, and by means of the advantages which the vicinity of the sea shore affords, it is carried on with great safety and facility. Their foreign trade consists chiefly in exchanging for colonial goods and manufactured articles, the fruits, wheat, rice, silk, wine, wool, oil, and cotton, of their own country. It has greatly increased since the opening of the intercourse with England. A large class of the Italian artisans are now constantly employed in manufacturing alabaster and marble ornaments for the English market; for the natural taste of the inhabitants, and their proximity to the finest models of ancient taste, has preserved for Italy her wonted superiority in the fine arts, amidst the wreck of every other species of industry. The bankers, in most Italian towns, have realized considerable fortunes, in consequence of the advantages which their capitals gave them during the revolutionary war. Universally, however, in Italy, the capitals which are acquired in commerce are, as soon as possible, invested in land. The whole ambition of the mercantile class is to arrive at the rank, and to participate in the public estimation of *Possidenti.* Hence a merchant, or banker, is satisfied with a moderate fortune, and stops short in the career of commercial enterprise, in order to extricate himself from a class to which a certain degree of contempt is attached; and when he becomes a landed proprietor, he generally educates his sons to idleness.

Manufacturers.

The *third* class, or that of manufacturers, is generally in a poor and depressed state. The main cause is, the great poverty of the agricultural classes, and the small expenditure of the landed proprietors, who possess almost the whole wealth of the country.

Professional Classes.

The *fourth*, or professional class, is very numerous in Italy. There is probably no country in Europe in which the number of lawyers is so great. Litigation, indeed, is the favourite amusement of the higher orders; and the entire absence of every other employment, or any political interest, makes them enter into it with a degree of ardour which, to a foreigner, appears very surprising. The multitude of lawsuits is principally to be ascribed to the minute subdivision of landed property, and to the variety of questions constantly occurring concerning those canals to which so much of the fertility of the country is owing. (Chateauvieux, 354.)

The clergy have been greatly reduced, both in point of number and opulence, by the events which

Italy.

followed the French Revolution. The convents were everywhere suppressed by authority of the French government. (Chateauvieux, 353.) Many of them, however, have since been restored to their possessions, but the greater part is still in the hands of lay proprietors. These new proprietors are chiefly lawyers, bankers, and tradesmen. (*Ibid.* 347.) The peasantry and agriculture of the country have gained hardly any thing by the change. The tenantry remain the same; their condition is unaltered; they only pay their rents to new masters. The old ecclesiastical proprietors let all their lands at half produce to their tenantry, like the other landholders, and they were more indulgent masters than those who have succeeded in their place. Hence it is a general observation throughout the country, that agriculture has gained nothing by the suppression of the monasteries. (*Ibid.*)

The clergy derive their income generally from foundations in land. In the Milanese, Piedmont, and the Venetian States, the tithe is so light that no complaints on the subject are heard: it usually varies from one-twentieth to one-fiftieth of the produce, and this extends only to particular lands. (Young, II. 271-2.) The suppression of the Jesuits in Tuscany was, by Leopold, converted into the means of relieving the cultivators of that Duchy from every species of tithe; the funds belonging to their order being formed into a fund for the gradual abolition of this burden. As the subsisting incumbents died, tithes were abolished in the parish, and the successor was paid out of this fund, or by a salary raised by an addition to the land-tax. At present, the patrimony of almost all the parishes in Tuscany consists in lands set apart for them. Of these the rector is the administrator, and he is bound by an oath, at entering into his office, to maintain them in good order, and, if possible, increase their produce. (Paoletti, 50.) In the Ecclesiastical and Neapolitan States, the numbers of the clergy were formerly very great. It was estimated that the ecclesiastics in the latter state amounted to 200,000 persons, who were proprietors of half the lands of the kingdom. Great part of these, however, have been confiscated during the Revolutionary wars; but what is the amount of the possessions which still belong to the church, cannot, with any accuracy, be stated.

It is computed, that, in the time of Bonaparte, 300,000 soldiers were raised at one period out of the Italian States; of which 80,000 were from the kingdom of Naples; 80,000 from the kingdom of Italy; and 140,000 from that part of Italy which was incorporated with the French empire. (Chateauvieux, 352.) The amount of the military class is now greatly reduced.

Class of Cultivators.

The *last* class, that of the cultivators, is by far the most numerous, and that which contributes the most to the wealth of the community. It is in its rural economy that we find the source, both of its great population, and of what remains of prosperity in Italy.

Manufactures and Commerce.

To this sketch of the different classes into which the population of Italy is divided, we shall subjoin a few remarks, illustrative of the history and present state of her manufactures and commerce. Her agriculture will be treated of at some length in the following chapter.

The main source of the wealth of Florence during the Republic was its woollen manufacture, which maintained above 30,000 souls. (Villani, Chap. XI. sect. 93.) At a single fair woollen goods to the amount of 12,000,000 of crowns were sold; and 1s. a-week on the wages of the woollen manufacturers alone built the superb pile of the Cathedral. (Young, II. 280.) The woollen and silk manufacturers at Florence are still of some consideration; and a considerable number of artisans live by making vases, statues, and other models of the fine arts, most of which are purchased by English travellers. At Venice, the chief manufactures are silk, velvets, glass, and beads; the exportation of which, thirty years ago, hardly employed 200 bottoms, the poor remains of 3300, which at one period were maintained in the service of the Republic. Its commerce is now almost annihilated, in consequence of the systematic oppression of the Austrian government. In the Veronese, it is computed they make 100,000 ounces of silk annually. (Young, II. 278.) The manufactures of Milan, and the cities under its rule, at one period were considerable. In 1123, there was sent to Venice alone, from the Milanese States, cloth to the amount of 900,000 ducats. (Guilini, XII. 362.) At present this manufacture is very much decayed, though it still maintains a considerable number of hands. It is computed that the value of the silk produced in the Milanese is not less than 900,000 livres, or L.300,000 annually, nineteen-twentieths of which is exported. (Veri, I. 236.) Considerable manufactures of mosaic, china, and other ornaments, are to be found at Milan. Bergamo had a woollen manufacture of great antiquity, which is not yet entirely decayed; and its export of silk sometimes amounts to L.300,000 a-year. It has a manufactory of iron and steel, as well as Brescia; but both are of little estimation, and beyond comparison inferior to the English. (Young, II. 278.) On the whole, so inconsiderable are the manufactures of Lombardy, that nine-tenths of its exports now consist of the rude produce of the soil. In the ecclesiastical states, a considerable manufacture of mosaics, cameos, necklaces, and other ornaments, is carried on, especially at Rome; and Bologna employs 7000 or 8000 persons in the working of crapes and gauzes, which are very beautiful; but, in other respects, the national fabrics are not worth noticing. Piedmont exports annually unwrought silk to the amount of 17,000,000 livres, or L.748,000 Sterling, and about L.30,000 worth of damasks; the remainder of its exports consist of agricultural produce. The velvets and damasks of Genoa still preserve their ancient reputation, though the sale for them is greatly diminished; and rich silk stuffs are manufactured to a considerable extent at Lucca, and the adjoining towns. In the Neapolitan territory, manufactures are few, and of small importance. Cotton is manufactured in the southern provinces of Sorrento and Otranto. At Nardo and Gallatona are made coverlets which are exported to all parts of the world. The porcelain of Naples

may vie with any in Europe in elegance of form and beauty of design; and at Teramo, in Abruzzo, there is a considerable manufactory of pottery, which is sent into Germany by the way of Trieste. Tarento and Francavilla produce a sort of muslins greatly inferior, indeed, to those of England, but of some consideration in that country. Upon the whole, silks and velvets are the staple manufacture of Italy, and in the various states of preparation employ more hands than all its other manufactures put together.

There is one species of manufacture which, though inconsiderable in point of value, is of infinite importance to a large proportion of the Tuscan population, that of straw bonnets, which is carried on universally by the cottagers' daughters in the vale of the Arno, and is one principal cause of the well-being of the peasantry in that delightful region. A good worker can earn from thirty to forty sous a-day. It brings an annual return of 3,000,000 francs, or L.132,000 Sterling, and this is entirely shared amongst the young women by whom it is carried on.

CHAP. II.

Agriculture.—In Lombardy.—In Tuscany.—In the Campagna of Rome.—In the Campagna of Naples.—State of the Peasantry in these different Districts.

The mode of cultivation pursued in the different provinces of Italy is as different as can well be imagined in a country whose climate is nearly the same. This difference arises from the entire difference of the soil, and natural productions in the mountainous, from what obtains in the level districts of the country.

Agriculture of Lombardy.

The great agricultural district of Italy is the plain of Lombardy and Piedmont. This magnificent plain is composed every where of a rich and deep loam. There are no gravel hills except near the Alps. The high mountains which overlook the plain pour down an immense number of streams, which are collected in canals, and conveyed in so many various directions, that there is scarcely any farm or meadow which has not the benefit of irrigation. This immense system of irrigation was completed at different times during the twelfth and thirteenth centuries, by the wealth and spirit of the commercial cities which filled the plain of Lombardy. The Naviglio Grande, which brings the water of the Tessino to the Milanese territory, was begun long before the date of any authentic records; but it was brought to Milan from Abbiate Grasso in 1177, and made navigable in 1271. (*Nuovo Raccolta dell Aquæ*, VII. 97.) The canal of Muzza was executed in 1220, and brings the waters of the Adda to Marignan, and irrigates the district of Lodi. (Verri, *Hist. de Milan*, I. 240.) The Canal of Treviglio, which carries the water of the Brenta to the territory of Treviglio, was made in 1303; and, in 1460, the Great Canal of Martisano was begun, still the admiration of engineers, for the costly aqueducts which carry it across the rivers in its course. This system of irrigation was completed in 1497, by Leonardo da Vinci, who united the Naviglio Grande to the Martisan; and both canals are so managed as to be emptied once a-year, for cleaning and repairs; the flood-gates being so nicely adapted, that all the superfluous waters which descend in torrents from the mountains are let off with perfect security. In 1296, a law was passed which gave every one the power of carrying water across the public highways, provided he erected stone-bridges; and since that time the system of irrigation has been gradually brought to such perfection, by means of little canals, branching off from the great ones, that there is now hardly a field to the eastward of the Tessino which is not amply provided with water.

Water is sold with as much accuracy as wine, at so much the hour, half-hour, or quarter. The usual price of an hour *per* week is 1500 livres. (Young, II. 168.) He who discovers a spring in his ground has the property of it, and may conduct it where he pleases, upon paying surface damages. These damages are all fixed by law. (Verri, 239.) Hence every new spring that is discovered becomes the head of a little canal; and the activity shown in economizing the water so produced is truly admirable. In the Milanese, a stream twenty-two inches broad and two deep, and running from the 24th March to September 4th, will sell for 1000 livres. (Young, II. 177.)

Nor is it surprising that these great efforts are made for the diffusion of water over this plain. Such is the effect of irrigation, that land which, without it, will only yield six livres an acre, is raised, by the application of water, to twenty livres. Grass fields, with an adequate supply of water, are mowed four or five times a-year. (*Ibid.*) The water is conveyed in little rills, planted on each side by willows, allowed to grow only to a certain height; in many places vines cluster up these willows, and their branches, spreading from tree to tree, are trained in pendent festoons. The inclosures are generally small, and the fields divided from one another, not by hedges, but rows of mulberries, poplars, and oaks. Such is the luxuriance of these woods, that the country, when seen from an eminence, or at a little distance, seems a continued forest; and this without any intermission, from Turin to Venice. (Chateauvieux, 15.)

The peasantry are everywhere *Metayers;* that is, half the stock requisite for cultivating the farm is furnished by the landlord, and half by the tenant; the former pays the taxes and repairs the houses; and the produce is equally divided between them. Few of the cultivators are proprietors of the ground which they labour. Throughout all Lombardy the farm-houses are large and well built. They are always constructed of red brick, and, uniting strength with neatness, preserve, notwithstanding the regularity and plainness of their form, a rustic character. The offices consist of a court of four equal sides, in the centre of one of which rises a square building of two stories. In the lower storey of this building the farmer lives; the upper forms his granary. The stables for oxen and cows lie on each side of the farmer's house, and complete one side of the square. On each of the other three sides of the court is a portico, from twenty to twenty-four feet wide, the roof of which is supported from with-

in by a range of columns, at the same distance from each other as from the wall. Half of the court is paved, and the other half is an area for threshing out the corn, and is composed of clay. All the fodder, straw, and implements about the farm are placed under the porticos. The manure is collected on the outside; and the exterior walls of the whole edifice are covered by vines. The neatness, cleanliness, and even elegance, of a Lombard farm-steading, is such as can hardly be imagined by those who have not visited that country.

The meadow part of the farm is let for a money rent, and this is often forty francs. The produce of the remainder of the farm is equally divided, as already observed, between the landlord and tenant. The labour is principally done by oxen, in most parts of the country. Generally speaking, the farms are small; from ten to fifty acres. (Chateauvieux, 17.) In the Milanese they are larger, and in some places extend to 700 or 800 acres. Some of the farmers there are possessed of large capitals; from 50,000 to 100,000 francs, and feed 100 cows. (Young, II. 154.) The farms in the vicinity of Padua are small; and the ruinous system of middlemen prevails there and in the Bolognese territory.

The rotation usually followed in Piedmont is, 1. Maize, with hemp or French beans. 2. Wheat. 3. Clover. 4. Wheat. The remarkable recurrence of the grain crops is the consequence of the abundance of manure procured by mowing the grass lands three or four times a-year; the whole manure of which is laid on the arable land. The maize is considered as a preparatory crop. It is planted in drills, and hoed and earthed up like our potatoes, and the land kept perfectly clean. It is extremely productive, and constitutes the principal food of the peasantry over the whole of Lombardy. A number of French beans or hemp are mixed with the maize. The clover is sown in spring with the wheat. It is cut in autumn after the wheat is down. In the spring following it is cut again, and ploughed down, after which the land is ploughed three times as summer fallow. Wheat is sown again in autumn, which closes the rotation. Thus in the course of four years are three crops for the use of man, one fallow, and two crops for cattle. To these must be added the crop of hemp, which is often considerable; that of silk, wine, vegetables, and fruit, besides the ample produce of the meadow land. A farm of sixty acres, under this management, feeds a family of eight or nine persons, maintains twenty-two head of cattle, of which two oxen, a cow, and two pigs, are fattened every year. The value of its silk amounts at least to 25 louisd'ors; it makes enough of wine for the use of its inhabitants, and nearly the whole crops of wheat, and all the produce of the dairy, is carried to market. (Chateauvieux, 30.)

The soil of the plain of Lombardy becomes richer as you move to the eastward; and in the Lodesan and Parmesan are found those admirable pastures which produce cheese celebrated over all the world. Every thing connected with the rural economy of this garden of Italy is interesting. Some of the farms are large, consisting of several hundred acres, and feeding above 100 cows; and so great is the advantage of making the milk from a large dairy, that, when the farms are small, the farmers club together, to make their milk in common. (Young, II. 154.) Twice a day the milk of fifty or sixty cows, belonging to a society, is sent to the principal house, where the dairyman keeps an account of each person's proportion. The cattle in this district are the Hungarian breed, and of unrivalled excellence; the defects in that race being completely extirpated, by a cross with the Swiss, for which purpose 2000 cows have for time immemorial annually passed the St Gothard. The cattle are always fed in the house, upon mown grass, a method by which great economy, both in point of fodder and manure, is effected. The manure here is all applied to the meadows, and after twelve or fifteen years, they are broken up, and yield a rotation of, 1. Hemp, followed by vegetables; 2. Oats; 3. Wheat and Vegetables; 4. Maize; 5. Wheat. In these districts, the major part of every farm consists of meadows.

The rotation in the arable districts of this tract of Lombardy is as follows:

1st Year, wheat, after it maize and hemp—manured.
2d —— Wheat.
3d —— Winter beans.
4th —— Wheat manured.
5th —— Clover ploughed in, after once mowing.
6th —— Wheat.

In the neighbourhood of Parma, tobacco is cultivated, and it comes instead of maize the first year.

This sketch may give a general idea of the husbandry of Lombardy; a country in which a more admirably system of culture is now pursued than any where else in Europe. In many places it is, of course, very different from what has been above described, and, in particular, rice crops are very frequent in the neighbourhood of Pavia, and thence eastward along the course of the Po. The rotation followed in the rice grounds is, 1. Rice; 2. Rice; 3. Rice; 4. Fallow and dung; 5. Wheat and clover; 6. Clover; 7. Clover; 8. Clover; 9. Flax and millet the same year, and then rice again as before. So great is the produce of this husbandry, that, on the rice grounds, 160 francs an acre is a common rent. In the Milanese also, two crops of corn are commonly gained in one year by sowing maize in July, after wheat, and wheat and millet, or rye, almost always are reaped in the same year. (Young, I. 203; Chateauvieux, 278.)

Agriculture of Tuscany.

The second agricultural district is that of Tuscany, in which the mountainous nature of the soil has rendered a totally different system of cultivation requisite. Nothing can be imagined more sterile in itself, or more adverse to any agricultural improvement, than the aspect of nature in the Appenines. Their sides present a series of broken rocks, barren slopes, or arid cliffs. The roots of the bushes, laid bare by the autumnal rains, are, by degrees, dried up by the heat of the sun. They perish, and leave nothing behind them but a few odoriferous shrubs dispersed on the rocks, to cover the wreck. The narrow ravines between them present, in summer, only the dry beds of torrents, in which fallen trees, rocks, and gravel, are accumu-

lated by the violence of the winter rains. This *debris* is brought down by the torrents into the wider vallies, and whole tracts of country are desolated by a sterile mass of stone and gravel. Thus the mountains and the vallies at their feet seem equally incapable of culture; but the industry of the Italians has overcome these obstacles, and converted mountains, to appearance the most sterile that imagination could conceive, into a succession of gardens, in which every thing that is most delightful, as well as useful, is assembled.

This astonishing metamorphosis has been effected by the introduction of the *terrace system of culture*, an improvement which seems to have been unknown to the ancient Romans, and to have been spread in Europe with the return of the Crusaders, in the twelfth and thirteenth centuries. (Chateauvieux, 300.) Nothing could oppose the destructive force of the torrents, but altering the surface of the hills, and thereby breaking the course of the waters. This was an immense work, for it required the whole soil to be displaced, and built up by means of artificial walls, into successive terraces; and this, in many places, could be effected only by breaking solid rocks, and bringing a new soil from distant places.

The artificial land, so dearly purchased, is designed for the cultivation of fruits and vegetables. The terraces are always covered with fruit-trees placed in a reflected sun. Amidst the reverberations of so many walls, the fruit is most abundant and superior in its kind. No room is lost in these limited situations,—the vine extends its branches along the walls; a hedge formed of the same vine branches surrounds each terrace, and covers it with verdure. In the corners formed by the meeting of the supporting walls, fig-trees are planted to vegetate under their protection. The owner takes advantage of every vacant space left between the olive-trees to raise melons and vegetables; so that he obtains, on a very limited extent, olives, grapes, pomegranates, and melons. So great is the produce of this culture, that, under good management, half the crop of seven acres is sufficient for a family of five persons; being little more than the produce of three-fourths of an acre to each soul. This little space is often divided into more than twenty terraces. (*Ibid.* 302.)

A great part of the mountainous part of Italy has adopted this admirable culture; and this accounts for the great population which every where inhabit the Italian mountains, and explains the singular fact that, in scenes where nothing but continued foliage meets the eye, the traveller finds, on a nearer approach, villages and hamlets, and all the signs of a numerous peasantry.

Continued vigilance is requisite to maintain these works. If the attention of the husbandman is intermitted for any considerable time, the violence of the rains destroy what it had cost so much labour to create. Storms and torrents wash down the soil, and the terraces are broken through or overwhelmed by the rubbish, which is brought down from the higher parts of the mountain. Every thing returns rapidly to its former state; the vigour of southern vegetation covers the ruins of human industry; and there soon remain only shapeless vestiges covered by briers. (*Ibid.* 303.)

In the valley of the Arno, the farms are extremely small; generally from three to ten acres. The peasants' houses are concealed from the eye of the passenger, by the olives which clothe the lower parts of the mountains, and by the luxuriant chesnut forests which adorn their higher ascents. They are generally, however, not more than 100 paces from each other, and are built of brick in the most elegant manner. For the most part they consist only of one storey, with a single door, and two windows in front. On the wall which surrounds it are often placed vases of antique forms, in which flowers, aloes, and orange trees, are growing. The houses are completely covered with vines, so that, during the summer, it is difficult to distinguish them from arbours. The land belonging to the farm lies round the houses, and is divided into fields by small canals, or rows of trees, some of which are mulberries, but the greatest part poplars. The poplars are pollarded, and each tree supports a vine, the branches of which are twined round in various directions, in such a manner, as to give the whole somewhat the form of the antique Tuscan vases. These divisions of the land are oblong squares, large enough to be cultivated by means of oxen, which here, as elsewhere, are employed in the works of agriculture. (Sismondi, *Agric. de Tosc.;* Chateauvieux, 76.) A pair is kept jointly by ten or twelve farmers, who employ them successively in the cultivation of their farm. They are of the finest Hungarian breed, and extremely docile. Every considerable farm maintains one horse, and a small painted cart, which serves for all the purposes of draught, and to carry the family to church. (Chateauvieux, 77.) The farmers have, in general, no other stock but heifers, which they buy at three, and keep till they are eighteen months old. There is hardly any meadow land, or artificial grass. The cattle are fed almost exclusively on the leaves of trees, the refuse of vegetables, and a little wild clover.

The rotation of crops is not uniformly the same; but it is very generally as follows:

1st Year, Maize and French beans, or other vegetables.
2d —— Wheat.
3d —— Winter beans.
4th —— Wheat.
5th —— Clover; sown after wheat in the spring, and followed by sorgho, which is a larger variety of parsnip. (*Ibid.* 78.) The land is manured only once in five years; nevertheless, such is the richness of the alluvial soil in the plain of the Arno, that the crops are all tolerably good.

The system of *irrigation* in this valley is a most extraordinary monument of human industry. Placed between two ridges of mountains, one of them very elevated, it was periodically devastated by numerous torrents, which were precipitated from the mountains, charged with stones and rubbish. To control these destructive inundations, means were contrived to confine the course of the torrents within strong walls, which serve at the same time

Italy.

for the formation of a great number of canals. At regular distances, openings are formed below the mean level of the stream, that the water may run out laterally, overflow the land, and remain on it long enough to deposit the mud with which it is charged. A great many canals, by successive outlets of the water, divide the principal current, and check its rapidity. These canals are infinitely subdivided, and to such a degree, that there is not a single square of land which is not surrounded by them. They are all lined with walls, built with square bricks; the scarcity of water rendering the most vigilant economy of it necessary. A number of small bridges connect the multitude of little islands, into which these canals subdivide the country. These works are still kept in good repair; but the whole wealth of Tuscany could not now furnish the sums requisite for their construction. That was done by Florence in the thirteenth and fourteenth centuries, in the days of her Republican freedom. (*Ibid*, 80, 85.)

This mode of cultivation is followed all over the valley of the Arno, and on the lower ranges of hills which compose the chain of the Appenines. In the higher regions, the severity of the climate renders a different mode of proceeding necessary. The mountain pastures, at the summit of the Appenines, feed numerous flocks, which migrate in winter into the Maremma of Sienna, and the Campagna of Rome. The chesnut forests, with which the country abounds, furnish the peasantry with most of their subsistence; but incessant industry extracts a scanty crop of corn from the better parts of the soil. Land is everywhere much subdivided, and the cultivators are generally, as in the Alps, proprietors of the lands which they cultivate. (Young, II. 157, 152; Sismondi, *Agric. de Tosc.*) The case is very different in the plains and lower regions. A large proportion of the people derive their subsistence from migrating in summer, to cut down the harvests of Tuscany, Lombardy, and the Campagna of Rome; and with the money thus acquired they return annually, or after the lapse of years, to their native hills, where they become proprietors, and, by strict economy, contrive to maintain themselves for the remainder of their lives. (Sismondi, *Agric. de Tosc.*) Almost all the mountain pastures are let from year to year, to the shepherds of the Maremma, who bring their flocks hither in the summer season. The rent they pay for the season is a piastre for a horse, five sous for a sheep, and three for a goat. These shepherds limit themselves to one species of animal. Some rear horses, others sheep, others goats. They have no fixed residence, but live in sheds in the Appenines in summer, and in the Maremma in winter. (Chateauvieux, 58, 61.) The introduction of the potatoe would be a signal advantage to the inhabitants of these mountainous districts.

Almost universally in Tuscany land is let to the peasantry at half produce. The proprietor pays all taxes, except the capitation tax, and generally furnishes the live stock, and repairs the houses. Leases are not usual; but the peasantry lose nothing by that circumstance. The right to the farm generally descends from father to son, the landlords hardly ever removing them. (Chateauvieux, 329.) The landlord is obliged to aid them in every season of distress;—a bad season often reducing them to the utmost misery. They never quit their mode of life, and have no means of rising in society.

Agriculture of the Maremma.

The third agricultural division of Italy is the Maremma, or the plains on the sea shore in Tuscany, and the Roman states, where the prevalence of the *malaria* renders it impossible to live permanently. This region is everywhere divided into great estates, and let in large farms. The Maremma of Rome, 40 leagues in length, and from 10 to 15 in breadth, and which feeds annually 67,000 horned cattle, is cultivated by only 80 farmers. These farmers live in Rome or Sienna; for the unhealthiness of the atmosphere precludes the possibility of their dwelling on the lands they cultivate. Each farm has on it only a single house, which rises in the midst of desolation. No garden, or orchards, or meadows, announce the vicinity of a human habitation. It stands alone in the midst of a vast solitude, with the cattle pasturing up to the walls of the dwelling.

The whole wealth of these great farms consists in their cattle. The farm servants are comparatively few, and they are constantly on horseback. Armed with a gun and a lance, the shepherds, as in the wilds of Tartary, are constantly in the open air tending the herds committed to their care. They receive no fixed wages, but are paid in cattle, which graze with the herds of their masters. The mildness of the climate permits the grass to grow during all the winter, and so the flocks are maintained there in that season. In summer, as the excessive heat renders the pastures parched and scanty, the flocks are sent to the highest ridges of the Appenines in quest of cool air and fresh herbage. The oxen, however, and cows of the Hungarian breed, are able both to bear the heat of summer, and to find food during its continuance in the Maremma. They remain, therefore, during all the year; and the shepherds who tend them continue exposed to the pestilential air during the autumnal months. The woods are stocked with swine, and the marshes with buffaloes. So great is the quantity of the live-stock on these immense farms, that on one visited by Mr Chateauvieux were cattle to the value of L.16,000 Sterling; and the farmer had two other farms on which the stocking was of equal value. (Chateauvieux, 157.)

These farms, however, are not exclusively devoted to pasture. The most favourable situations for wheaten crops are selected, and the sheep are folded there during the winter, in order to enrich the soil. In spring the oxen which range at large on the pastures are yoked in the plough by labourers hired at Rome for the purpose. The shepherds, who attend the cattle, are incapable of any such labour. The inhabitants of the cities bordering on the Maremma, and of the mountains, do the whole agricultural labour of the farm. These labourers get 40 sous a-day, and are furnished with bread from Rome by their employers. As many workmen are hired as there are oxen to plough with, in order that the work may be done as soon as possible. A farmer, in the Campagna of Rome, often yokes 100 ploughs at once. When the work is done, the labourers return to

Italy.

the cities, and the oxen are dismissed to their pastures.

This first ploughing is only for the purpose of breaking the earth, and exposing the roots of the weeds to the sun. In a month the land is again ploughed, and the roots burned. These two ploughings are followed by two others at equal intervals in a cross direction to the first; so that, by the middle of September, the earth has been broken up four different times. The seed is then sown, and covered in by a slight ploughing. The harvest takes place the following summer, after which the land is left to rest for many years.

The farmer pays a money rent, which is estimated only for the arable part of the farm. He has a lease for years, and pays 18 francs the French acre, which is just equal to the Scotch. The land which is not susceptible of tillage is not estimated in the rent, although from it the farmer often makes his greatest profit, as the woods and marshes feed the horned cattle, pigs, and buffaloes.

A farm, which Mr Chateauvieux visited, consisted of 6000 acres of arable land, with an equal portion not fit for the plough. For this he paid 22,000 piastres, which, reckoning the piastre at 4s. 2d., is L.4583, 6s. 4d. Sterling, being 15s. the acre for the arable ground. The portion of 6000 arable acres was divided into nine parts, one of which was annually under crop, one fallow, and seven in grass. The land which was not arable fed 700 cows, and 2000 pigs. About one-tenth of these, however, belonged to the shepherds, and constituted the pay they received. The farmer cleared annually about 5000 piastres, or L.1200, besides 5 *per cent.* on the capital vested in his flocks. From this it appears, that the Campagna of Rome, how desolate soever in appearance, is by no means entirely unproductive.

Great efforts were made by Pius VI., and after him by the French, for the draining of the Pontine marshes. His plan was to draw parallel drains at certain distances from each other, running from north to south, and falling into the sea, at Bocca di Fuime, near Terracino. At an angle of 45° with these, cross-drains were to be drawn also parallel to each other. Two only of these canals were finished by this Pontiff, at an immense expence of human life (Eustace, I.); but they drained a very considerable portion of the marshes; and their complete success convinced the French engineers whom Bonaparte employed, that this was the proper mode of proceeding. Under the skilful direction of M. Prony, the works were revived with great activity; but the overthrow of the empire of Bonaparte prevented any considerable progress being made. The portion drained is covered with a beautiful turf, and yields magnificent crops of wheat, maize, hemp, and legumes. Such is the richness of this virgin soil, that many fallows are necessary to clear off the weeds, which grow with extraordinary luxuriance. The inhabitants of Piperno and Sermonetto, and of all the villages situate on the declivity of the mountains, which bound the marshes on the eastern side, rent portions of this land, and cultivate it without changing their dwellings; for experience has shown, that the drained land is nearly as much subject to the *malaria* as that which is still under water. (Chateauvieux, 173.)

Agriculture of the Campagna of Naples.

In the *Terra di Lavoro*, or Campagna of Naples, the extreme richness of the soil has given rise to a mode of culture different from any which has yet been described. The aspect of this great plain is, perhaps, the most striking in point of agricultural riches that exists in the world. The great heat of the sun renders it necessary that the grain should be shaded by trees; and, accordingly, the whole country is intersected by rows of elms or willows, which divide it into small portions of half or three quarters of an acre each. A vine is planted at the foot of every tree; and such is the luxuriance of vegetation, that it not only rises in a few years to the very summit, but extends its branches in a lateral direction, so as to admit of festoons being trained from one tree to another. These trees are not pollarded as in Tuscany and Lombardy, but allowed to grow to their full height, so that it is not unusual to see a vine clustering round the top of a poplar 60 or 80 feet high. Under their shade the soil produces annually a double crop, one of which is of wheat or maize. Melons are cultivated in great quantities, and with hardly any manure. Thickets of fig-trees, of peaches, and aloes, grow spontaneously on the borders of the fields. Groves of oranges clothe the slopes, and spread their charming perfumes over the adjoining country; while the rocky eminences are covered with vines, which produce fruits of the most delicious flavour.

This rich plain is cultivated entirely by poor Metayers, who have farms from three to seven acres each, which they hold from the proprietor, on condition of paying him two-thirds of the produce. The redundance of the population has so depressed the condition of the labouring classes, as to reduce them to the necessity of giving this proportion of the produce to the landlord, in place of a half, as in the north of Italy. Ploughs are seldom used in cultivation; the whole is done by means of the spade. The soil being mixed with ashes is so easily worked, that even children assist in the digging. Melons are sown in spring, and, after their fruit is gathered, wheat is sown, which ripens in September, and when the stubble is dug in, beans or clover, which vegetate during the winter, and are cut twice or thrice for the use of the cows or buffaloes. Most of the cottagers have a few goats, and one or two cows, which are fed chiefly on the leaves of the trees. The richer class have a horse or ass to carry their produce to market.

The rotation generally pursued in this Campagna is as follows:

1st year, Maize, with manure.
2d —— Wheat.
3d —— Onions and legumes.
4th —— Wheat, followed by beans or clover.
5th —— Melons, followed by maize.

This course of husbandry yields seven crops in five years; of which four are leguminous and three of corn. Besides their regular crops, they have the produce of the vines and other fruits which grow on the same land, and the leaves of the trees for their cattle. A

family of five persons is here maintained on *a third* of the produce of five acres; being the produce of *one-third of an acre to each soul.* The population in the Campagna is nearly 5000 to the square league. No where in the world, except perhaps in India, is such richness of soil and density of population to be found. (Chateauvieux, 215.)

It only remains, in order to conclude this sketch of Italian agriculture, to mention the cultivation of Cotton, which is carried on to a considerable extent in the southern provinces of Naples, especially in the vicinity of Otranto, and in the Abruzzo. But the district where it is conducted with the greatest success, is in that fine valley which lies between Pompeii and Salerno, on the road to Pestum. It is there introduced into the regular rotation of crops. The farmers of this district produced for export, in the year 1812, 60,000 bales of cotton. (*Ibid.* 223.)

The land intended for this crop is turned over with the spade in March, and the seeds are sown in lines at the distance of three feet. The plants in the lines are two feet asunder. No manure is required for the soil; it needs only to be kept quite clean, and for this purpose women are employed during the whole season in weeding. As soon as the flowering is over, the ends of the branches are nipt off, in order to direct all the sap to the fruit. The harvest, which is long and tedious, consists in collecting the capsules as they ripen. Nothing is then required but to clear the cotton by separating it from the seeds. This operation gives employment to the women and children.

The above described course of husbandry, pursued in the Terra di Lavoro, leaves no room for this crop; and yet none of the crops there raised can be dispensed with. The Metayer, therefore, begins with the cultivation of maize, for which the land is manured,—wheat follows it, and beans are planted the same year for a winter crop. The land on which they grow is prepared for the cotton seeds by the end of March in the spring following; after it is harvested wheat is again sown the same autumn, to which clover succeeds. Melons succeed the clover, and legumes, planted as soon as the melon crop is taken off, occupy the ground until the spring, and finish the course. The rotation, therefore, is as follows:

1st year, Maize, manured.
2d —— Wheat, followed by beans.
3d —— Cotton.
4th —— Wheat, followed by clover.
5th —— Melons, followed by legumes.

This system yields eight regular crops in five years; besides the grapes, fruit, and leaves, which the same land produces. (*Ibid.* 225.)

Such is the system of husbandry pursued in the best parts of the kingdom of Naples. In the Maremma of Pestum the same pastoral habits obtain as in those of Rome and Tuscany; and the terrace husbandry is to be seen in some part of the mountains of Abruzzo and Calabria. But, in general, the Appenines in Naples are cultivated with much less industry than in the Tuscan states, the natural consequence of the oppressions of the nobles, and the despotic nature of the government. (*Ibid.* 233.) The land is very much divided, and belongs, in the higher regions, to the peasantry; but their entire want of skill and capital renders them incapable of availing themselves of the advantages which their delightful climate affords. The most favoured spots only are selected for grain and vegetables; the greater part of the mountains are left to the olive and sweet chesnuts, which here grow in the utmost luxuriance, and constitute the principal support of the people. They migrate in great numbers to the low country in the season of harvest, and carry back with them a small pittance for the winter months. Yet notwithstanding their poverty, the climate compensates many disadvantages. The little gardens, which their children manage, furnish fruits, which are esteemed luxuries among the rich in northern climates.

General State of the Peasantry.

The condition of the peasantry all over Italy, with the exception of Tuscany, is indigent and miserable. They live, indeed, in the midst of natural beauty; their dwellings are adorned with fruits and flowers; and the traveller, on a cursory view, is apt to imagine that the inhabitants participate in the riches with which they are surrounded. But if he enters their dwellings the illusion is destroyed. He will find them crowded in old and uncomfortable houses, and living in a manner the most penurious. In Lombardy, the labouring classes are, in general, ill clad, without shoes or stockings, and destitute of every species of comfort. Inhabiting a country which abounds in wine, they rarely taste anything but water. "The division of land among the tenantry," says Mr Young, "leads them to grasp at the least prospect of maintenance for a family; and population goes on with unlimited force, in consequence of the ignorance, the little frugality, and *the absence of all artificial wants among the people.*" In the districts of Padua, Modena, and Bologna, and even a great part of the Ecclesiastical States, the system of *middle-men* prevails, and the condition of the cultivators is uniformly worse than where they hold directly of the landlord.

The situation of the people in the Tuscan States is greatly superior to what obtains in other parts of Italy. The number and opulent appearance of the villages, the inns and handsome shops, all bespeak the greater comfort of the middling and lower orders: and remind the English traveller of the cheerful and prosperous aspect of his own country. Nor is the comfort of the people less conspicuous in their dress and dwellings. On ordinary occasions their dress is neat and substantial, and on Sundays and festivals, costly and handsome. This obtains, however, chiefly in the valley of the Arno, where, as already observed, the women add to the earnings of the family by their manufacture of straw hats. In the remoter districts of the country, the peasantry are in a more depressed condition; bread and liquorice form their ordinary food, and meat is tasted only on Sundays; and not unfrequently the Metayers are so poor, that the landlord is obliged to lend them corn for food, when the produce of the harvests has been unfavourable. (Young, II. 156; Chateauvieux, 79.)

Every traveller observes that the condition of the people in the Roman States is worse than in the

northern parts of Italy. But their situation is still more depressed in the kingdom of Naples,—in that country where the plains annually yield a double crop, and where the mountains spontaneously produce the finest and most luxuriant fruits.

The miserable condition of the Neapolitan peasantry is not surprising when the multiplied oppressions and exactions to which they are subjected are considered. The *barons* have the right of life and death within their jurisdiction. They have a legal claim to one-tenth of the produce that grows within their lordships, and the exclusive right of erecting an oven, an oil-press, an inn, a mill, and a butcher's shop, that is, of exercising all the necessary arts. (De Sali's *Travels*, 197.) These privileges are sold by them by auction to the highest bidder. Many lordships, in addition to this, have the right of levying road and bridge-money, though both are generally in the most dilapidated state. If the baron be an oppressive and unthinking master, or if he does not reside on his estate, and the management devolves on a steward, the condition of the vassal under these privileges is truly deplorable. It is with the utmost difficulty they are able to pay the charges made upon them; and any appeal against injustice is out of the question, as the baron is himself the judge, and his decision can be brought under review only by endless litigation and at vast expence. (*Ibid.* 202.)

The *manna*, a substance which exudes from the leaves of a certain species of ash, belongs everywhere to the King; and to gather it a certain number of labourers are furnished by the lord of the barony. During the season that the collection of the manna lasts, which is about a month, none of the labourers so employed are allowed to absent themselves even for a day, to look after their own scanty harvest. If the peasantry are detected burning or injuring any of the trees on which this royal substance grows, or if the smallest quantity of the juice is found in their houses, they are punished with the utmost severity. The taxes are all farmed, and the mode of collecting them adopted by the farmers of the revenue is in the highest degree oppressive.

CHAP. III.

Government.—Police.—Manners.—Customs.—Charitable Establishments.

In all the states of Italy, the sovereign is vested with absolute power. The judgments even of the courts of law are reversed and altered according to his pleasure. He cuts off the rights of succession by legitimating a bastard; and sets aside the provisions made for families by dispensing with the fetters imposed on the eldest son. The privileges of public bodies are not less at his mercy than the rights of individuals; he changes at will the customs and privileges of cities, and the subsisting prerogatives of the different orders of the state. As everything depends on the will of the prince, so every measure is carried into execution by his sole authority, and without the intervention of any public deliberation, or the consultation of any class of men. Any public criticism on political subjects would be considered as a high offence, and instantly prohibited. Modern history even is in many places an interdicted subject. The newspapers are subjected to the most rigid censorship, and contain almost nothing under the head of Italy but frivolous details of fashionable life.

The freedom of individuals is abridged to an inconceivable degree by the oppressive power which is everywhere vested in the *police*. To those who have lived only in Britain, it is hardly possible to convey a conception of the authority which, in all the Italian States, is thus exercised over the movements of individuals. In the provinces subject to Austria, especially, they have established a system of *surveillance* which makes them acquainted with everything that is going forward in private families. No Austrian subject is allowed to leave the Austrian provinces, unless his passport is signed by the Director-General of the Police at Vienna; and no foreign traveller can enter the Austrian territories unless his passport is signed by the Austrian Ambassador at some foreign court. It may here be observed, however, that the police treat natives in a much more despotic manner than foreign travellers. To the honour of the government of Florence, it must be admitted, that the police throughout all its territories, like every other branch of the government, is much less oppressive than in the rest of Italy.

It is of the nature of despotic government, however, to fail in the attainment of its own objects: and while it professes to preserve the public safety better than any other, it is incapable of affording that strong restraint upon crime which springs from the co-operation of all classes in a free country. In the Roman and Neapolitan provinces, robbery and murder are so common, as to have rendered travelling in many districts highly dangerous. Robberies are committed by large bodies of ten or twenty persons. If no resistance is made, they are not, in general, guilty of acts of cruelty. It is a common practice with these bands to carry off some individual who is connected with wealthy relations, and having got him secured in their retreats, they intimate to his relations, that, unless he is redeemed within a limited time, they will put their captive to death. A particular spot is assigned, where the ransom is to be deposited; and, upon its being found there, the prisoner is conducted blindfold, in the night, to the high road, and there set at liberty. Instances frequently occur in which 4000 or 5000 crowns are given to redeem individuals from this perilous situation. The Alban Mount is a favourite haunt of these depredators. They made several attempts to carry off Lucien Bonaparte from his villa at Frescati, and actually, on one occasion, succeeded in seizing his secretary. The road from Terracino to Naples is guarded by picquets of soldiers, placed at the distance of a mile from each other; but, notwithstanding these precautions, travelling there cannot yet be considered as perfectly safe. Such is the weakness of the Roman government, that the Pope, under the able direction of Cardinal Gonsalvi, actually deemed it prudent to enter into a treaty with a leader of banditti, who surrendered himself on condition of being confined two years in the Castle

of St Angelo, on a pension of about eighteenpence a-day, at the expiration of which period he is to be set at liberty. When the writer of this article was in Rome (in 1819), this noted criminal, known to have committed many murders, and numberless acts of robbery, was living much at his ease, in that celebrated fortress.

In Italy the higher classes reside almost constantly in towns. During a few months in autumn, indeed, some of them resort from Milan to villas on the banks of the Lake of Como; from Florence to the baths of Lucca; from Naples to Castello Mare, on the adjacent shores; and the Malaria of Rome drives the whole of the wealthier classes to Tivoli, Frescati, or Albano, during the dangerous season of August and September. Many villas, in beautiful situations, are to be seen round the Italian lakes, on the hills which surround the valley of the Arno, and on the enchanting shores of the Bay of Naples. But these are occasional, not permanent residences. Nowhere is a *country house*, in the English sense of the word, to be seen. The idea of building and living on his estate, seems never to enter the mind of an Italian proprietor. Field-sports are wholly unknown in the north of Italy, as might well be expected among a people whose habits are formed entirely to a city life. What they call going to shoot at Genoa, is sitting down in a little *bosco*, or wood, composed of ten or twelve young trees, in the corner of a garden, where the sportsman fires at crows and magpies, as they fly past. In Naples, however, the love of shooting is very common, and is particularly fashionable at Court; but the mode in which it is practised, by collecting an immense number of wild animals, in some enclosed space, and firing at them as they issue from an outlet, accords but ill either with the feeling of *fair play* between the sportsman and his game which prevails in England, or with the active and energetic habits from which the love of it in this country has arisen.

It is one consequence of this almost entire oblivion of the country by the Italian landholders, that the noble youth are bred up in habits of indolence and inactivity, which, to an inhabitant of the north of Europe, seem altogether contemptible. They are seldom to be seen before dinner, but trifle away the forenoon, or occupy it in the pursuits of gallantry. The nobles dine in general alone; and invariably drive in the afternoon to the Cassino, or the Corso, where every lady is attended by her *cavaliere serviente*. The cavalcade proceeds to a fashionable confectioner's, where ices and lemonade are procured, and thence moves on to the opera. Here cards or conversation supply the amusement required by persons doomed daily to witness the same sort of performance. This style of manners prevails alike in the least as in the greatest towns; for, however inconsiderable the population of a city may be, it has its theatre and its Corso.

The universal disposition of the Italian proprietors to this mode of life, is the cause of the vast number of towns which are to be met with in every part of Italy, more especially in the plain of Lombardy; and of that polish of manners, which has descended so low in the scale of society. The coarseness which in this country too frequently disgraces the middling classes, and tarnishes the sterling virtues they possess, is there in a great degree unknown. The continual presence of all the higher orders, and the constant display of their manners in the places of general resort, has given to the middling and lower classes a degree of elegance, and a taste for the enjoyments of cultivated life, to which there is nothing comparable in any other part of Europe. Intoxication is almost entirely unknown, or, when it does occur, is looked upon with the utmost abhorrence. The amusements of the lower orders in the cities consist of dancing, singing, conversation, walking, and frequenting the public theatres. Even the peasants in the country participate in those elegant amusements, which seem natural to this genial climate. An English traveller being benighted in the Appenines, near Carrara, two years ago (1819), not only met with a most hospitable reception from a small farmer, who refused to accept any remuneration, but was charmed the whole evening by his three daughters, who had recently completed their education at Leghorn, and sung in parts in the most beautiful manner. Every peasant, in the vale of the Arno, has a horse and small cart, which is used partly to convey the family to church, and partly to carry the daughters to the rustic balls, which, during the summer months, are frequent in Tuscany. (Chateauvieux, 76.) Generally speaking, the Italian peasantry are a kind, affectionate, and contented people, who, though poor, enjoy with thankfulness the bounties of nature, without repining at the humble lot which providence has assigned them.

The taste of the middling and lower orders for the fine arts, and their capacity of appreciating their excellencies, is very remarkable. The tradesmen in towns, the persons whom you meet with in public conveyances, discuss the merits of poetry, music, and architecture, with an enthusiasm and a discrimination, which is hardly to be found in the most polished circles on the north of the Alps. Even the peasantry display a taste in works of design, which no other country exemplifies. If a Virgin and Child are painted on the exterior of a cottage by the meanest artisan of the village, the work has a grace and air peculiar to Italian painting. Nor is the taste of the people less conspicuous in their dress and habitations. The farm-yards in Lombardy are surrounded with porticos and colonnades, composed, indeed, of the simplest materials, but chaste and elegant in their design; and some of the most striking features of Italian landscape consist of the picturesque forms in which the village churches and common country houses are built. It has long been matter of proverbial remark, that the Italians have an instinctive taste for music; and the proof is to be found not only in the nice discrimination of the beauties of the opera, which is displayed even by the lowest of the populace, but in the charming airs which are sung in every part of the country.

One remarkable peculiarity remains to be noticed, namely, the fondness which all ranks manifest for the exhibitions of *Improvisatori* composers, and the singular talent for this species of exhibition which is frequently to be met with. In the streets of Venice,

of Rome, and Naples, the attention of the traveller is often arrested by a group of persons who surround some wandering composer of this description; and it is difficult to say which is most worthy of astonishment, the ease of the language in which the tale is delivered, or the intense interest which is evinced by the audience. Nor is it only among the lower classes that this passion is prevalent. It exists equally in the highest and most cultivated ranks; and the talent which the performers display is such as can scarcely be credited by those who have not witnessed their exhibitions.

When the *Improvisatore* is to make an exhibition, he demands a subject; and after six or eight minutes' thought begins his song, which often extends to five or six hundred verses, in which, not unfrequently, noble bursts of passion and poetical feeling captivate and astonish the audience. Many of these extempore composers voluntarily select the most difficult versification: sometimes the triple rhime of Dante, sometimes the octavos of Tasso.

Nor is it only among the Italian men that this singular talent manifests itself. The most admirable Improvisatoris of modern times have been found in the other sex. The celebrated Corilla, who was crowned at the Capitol, captivated all Italy by the brilliancy of her imagination, and the elegance of her manner; and suggested to the most distinguished female writer of modern times the original of her inimitable Corinne. La Faulistici of Florence, and La Bandittini of Bologna, have been celebrated in a lesser degree; the former for the melody of her versification, and the latter for the vast extent of the classical and historical information which she introduced into her poetry. The most remarkable Improvisatori of the present day is Madame Mazzei, a lady of high rank at Florence, who surpasses all her predecessors in the fertility of her imagination, the harmony of her style, and the perfect regularity of her versification. She does not sing, and has little power of recitation; but when she begins an improvisatory composition, her language and manner bear the marks of the highest poetical genius.

The dress of the peasantry is extremely various, and, in general, highly picturesque. In Naples, more especially, and in the mountainous part of the Neapolitan territory, the colours they wear are commonly scarlet and blue; and the warmth of the climate obliges the men to throw their coats over their shoulders in a manner peculiarly adapted for painting. When we see the brilliant and varied colours of the dress of both sexes in the Italian villages, and attend to the rapid and violent gesticulations into which the people throw themselves even in ordinary conversation, it is not difficult to perceive whence the Italian painters have drawn both the conception of drapery, and the extraordinary power of representing passion which characterizes their school.

The corruptions of religion in this country are universally known; but it is but justice to the Italian parochial clergy to say, that their lives are often spent in the most exemplary manner; and that, by a rigid adherence to the practice of virtue, they not only present a most salutary example to their flocks, but counteract, in a great measure, the pernicious effects of some of the religious doctrines which they are obliged to inculcate. In the mountains, more especially, which surround the Italian lakes, or which shut in the delightful valley of the Arno, they live on the most cordial terms with their parishioners; and in the unnoticed discharge of their duty, present an example which may put many northern ecclesiastics to the blush for the opportunities of doing good they have neglected, and the great acquirements they have turned to no useful purpose.

In justice to the peasantry, it must also be observed, that they seem generally to be strongly impressed with their religious duties, and to join with sincerity in the exercise of devotion. To them, the Catholic religion is divested of most of its worst consequences; and the universal charity which it inculcates has had a material effect in softening and humanizing their manners.

In the great Christian virtue of *charity*, indeed, none of the Italians, of whatever rank or description, can be accused of being deficient. A population, which has nearly reached the utmost verge of subsistence, and the continued pressure of despotism, necessarily occasion a great deal of misery; and the same causes to which the misery is owing, have materially diminished the ability of the higher orders to relieve it. Yet, the provision which is made in most of the great towns, for the relief of distress, and of the poor, is such as to afford a splendid example of Christian beneficence. There are above sixty charitable foundations in Naples. Of these, seven are hospitals for the sick; thirty are receptacles for orphans, foundlings, and other destitute persons; five are banks for the occasional relief of such poor persons as stand in need of the loan of small sums of money, and the others are schools or confraternities. (Eustace, I. 499.) The income of these establishments is very considerable, and is derived principally from grants of land received from the piety of former times; but the expenditure is generally greater than the regular income. But the deficiency, however great, is abundantly supplied by donations, most of which come from unknown benefactors. (*Ibid.*)

All the other cities exhibit more or less the same amiable concern for human suffering. It is computed that the annual revenue of the charitable institutions of Milan amounts to L.87,000 a-year. (Young's *Travels*, II. 645.) In the great hospital, there are commonly from 2000 to 3000 patients; yet such is its revenue, that the directors are enabled annually to divide a large surplus of money among the other charities. The other charitable institutions of that great city are very numerous.

Without doubt, many of these charitable establishments are attended with pernicious consequences, and this has been very forcibly observed by an intelligent French writer (Lalande, Vol. V. 166), who ascribes to the great number of hospitals in Rome, and the facility with which soup and alms can be procured at the convents, much of the mendicity and idleness which prevail in that metropolis. Yet misdirected and pernicious as this charity may often be, it is impossible to refuse admiration to the truly Christian spirit from which it has arisen; and it

Italy || Jurisprudence.

is not to be forgotten, that this virtue is strongly and variously exemplified, even in the highest ranks. The society of the *Misericordia* at Florence includes 400 persons, among whom the principal nobility are to be found. Their duty is to attend the sick and bury the dead; and they permit no circumstance, however painful, to interfere with this duty. (Williams's *Travels*, I. 143.)

Much of all this is, without doubt, to be ascribed to the efforts of the clergy, who incessantly inculcate charity, as the most efficacious means of atoning for a life of wickedness. But it is not, perhaps, unreasonable to conclude, that despotism, by entirely depriving the rich of employment or any species of political interest, has had a material influence in directing towards charitable and benevolent objects, those warm feelings which the Italians possess in a greater degree than any other people of Europe, and which cannot be satisfied, at least in advanced years, by the heartless gallantry of a fashionable life.

The works chiefly referred to in this article are the following: Sismondi, *Histoire des Republiques Italiennes*, 16 Vols. Paris, 1809-1818.—Sismondi, *Agriculture de Toscane*, Geneva, 1802.—Chateauvieux, *Lettres ecrites d'Italie*, 1812. 8vo.—Young's *Travels in France and Italy*, 4to. Lond. 1796.—Daru, *Histoire de Venice*, 8 Vols. Paris, 1818.—De Sali's *Travels in Naples*, 8vo. 2 Vols.—Denina, *Tableau de Haute Italie*, Paris, 1805.—Verri, *Historia de Milano*, 8vo. 1712. Milan.—Villani, *Historia*, Milan, 1626, Folio.—Paoletti, *l'Agriculture de Toscane*. —*Nuova Raccolta delle Aque*, 9 Vols. Milan, 1736. —Lalande, *Voyage d'Italie*, 5 Vols. 8vo. Paris, 1802. —Eustace's *Travels*, 2 Vols. 4to. Lond. 1813.— Williams's *Travels in Italy and Greece*, 2 Vols. 8vo. Ed. 1819. (I. I. I.)

JURISPRUDENCE.

The object and end of the science, which is distinguished by the name of Jurisprudence, is the protection of rights.

The end of Jurisprudence, viz. the Protection of Rights.

The business of the present discourse is, therefore, to ascertain the means which are best calculated for the attainment of that end. What we desire to accomplish is,—the protection of rights: What we have to inquire is,—the means by which protection may be afforded.

Importance of the Inquiry, as involving Human Happiness.

That rights have hitherto been very ill protected, even in the most enlightened countries, is matter of universal acknowledgment and complaint. That men are susceptible of happiness, only in proportion as rights are protected, is a proposition, which, taken generally, it is unnecessary to prove. The importance of the inquiry, therefore, is evident.

Confusion in the vulgar uses of the word Right.

It is requisite, as a preliminary, to fix, with some precision, what we denote by the expression *rights*. There is much confusion in the use of this term. That disorderly mass, the Roman law, changes the meaning of the word in the two members into which it divides the subject, *Jura Personarum* and *Jura Rerum*. In the first of these phrases, the word *Jura* means a title to enjoy; in the second, it must of necessity mean something else, because things cannot enjoy. Lawyers, whose nature it is to trudge, one after another, in the track which has been made for them; and to whose eyes that which is, and that which ought to be, have, often, no mark of distinction, have translated the jargon into English, as well as into other modern languages.

This is not all the confusion which has been incurred in the use of the word *right*. It is sometimes employed in a very general way, to denote whatever ought to be; and in that sense is opposed to wrong. There are also persons, but these are philosophers, pushing on their abstractions, who go beyond the sense in which it is made to denote generally whatever ought to be, and who make it stand for the *foundation* of whatever ought to be. These philosophers say, that there is a right and a wrong, original, fundamental; and that things ought to be, or ought not to be, according as they do, or do not, conform to that standard. If asked whence we derive a knowledge of this right and wrong in the abstract, which is the foundation and standard of what we call right and wrong in the concrete, they speak dogmatically, and convey no clear ideas.* In short, writers of this stamp give us to understand, that we must take this standard, like many other things which they have occasion for, upon their word. After all their explanations given, this, we find, is what alone we are required, or rather commanded, to trust to. The standard exists,—Why? Because they say it exists; and it is at our peril if we refuse to admit the assertion. They assume a right, like other despots, to inflict punishment, for contumacy, or contempt of court. To be sure, hard words are the only instrument of tyranny which they have it in their power to employ. They employ them, accordingly: and there is scarcely an epithet, calculated to denote a vicious state of the intellectual, or moral part, of the human mind, which they do not employ to excite an unfavourable opinion of those who refuse subscription to their articles of faith.

Use of the term Right, in the science of Jurisprudence.

With right, however, in this acceptation, we have at present no farther concern than to distinguish it clearly from that sense in which the word is employed in the science of jurisprudence. To conceive more exactly the sense in which it is employed in that science, it is necessary to revert to what we established, in the article GOVERNMENT, with regard to the end or object of the social union, for to that,

* See the writings of Kant and his followers, *passim;* see also Degerando, and others of his school, in various parts of their works.

Jurisprudence.

every thing which is done in subservience to the social union, must of course bear a reference.

In that article it appeared, that, as every man desires to have for himself as many good things as possible, and there is not a sufficiency of good things for all, the strong, if left to themselves, would take from the weak every thing, or at least as much as they pleased; that the weak, therefore, who are the greater number, have an interest in conspiring to protect themselves against the strong. It also appeared, that almost all the things, which man denominates good, are the fruit of human labour; and that the natural motive to labour is the enjoyment of its fruits.

That the object, then, of the social union, may be obtained; in other words, that the weak may not be deprived of their share of good things, it is necessary to fix, by some determination, what shall belong to each, and to make choice of certain marks by which the share of each may be distinguished. This is the origin of right. It is created by this sort of determination, which determination is either the act of the whole society, or of some part of the society which possesses the power of determining for the whole. Right, therefore, is factitious, and the creature of will. It exists, only because the society, or those who wield the powers of the society, will that it should exist; and before it was so willed, it had no existence.

It is easy to see what is the standard, in conformity with which the rights in question *ought* to be constituted; meaning by *ought*, that which perfect benevolence would desire. It is the greatest happiness of the greatest number. But whether rights are constituted, that is, whether the shares of good things are allotted to each, according to this standard, or not according to this standard, the allotment is still the act of the ruling power of the community; and the rights, about which the science of jurisprudence treats, have this alone for the cause of their existence.

The principal ideas involved in the Jurisprudential sense of the word Right.

In this complicated term, it is obvious that there is involved, on the one hand, the idea of the person to whom a share is allotted, and, on the other hand, an idea of the things which are allotted. The one is the owner of the right, the person to whom it belongs; the other is the object of the right, namely, the person or thing over which the right gives certain powers.

All Objects of Rights are things desired; and desired as means to an end.

All rights of course are to objects of human desire,—of nothing else need shares be allotted. All objects which men desire, are desired, either as the end, or as means. The pleasurable state of the mind is the end; consisting of the feelings of the mind. It would be absurd, however, to speak of giving a man a right to the feelings of his own mind. The objects of desire, therefore, which are the objects of right, are not the pleasurable feelings themselves, which are desired as the end, but the objects which are desired as the means to that end.

The Objects of Rights are twofold, viz. either Persons or Things.

Objects of desire, as means to that end, may be divided into the class of persons and the class of things. Both may be the object of rights. In framing our language, therefore, we may say, that all rights are the rights *of* persons; but rights may be *to* either persons or things.

All that men desire, either with persons or things, is to render them subservient to the end, for which they are desired as means. They are so rendered by certain powers over them. All rights, then, when the term is closely investigated, are found to mean powers; powers with respect to persons, and powers with respect to things. What any one means when he says that a thing is his property, is, that he has the power of using it in a certain way.

Rights, when closely invested, mean Powers—legalized Powers—Powers with respect to Persons, and Powers with respect to Things.

It is no part of the present inquiry to ascertain what rights *ought* to be constituted, or what rights perfect benevolence would choose to see constituted. That belongs to the question how government should be constituted; in other words, how the powers which are necessary for the general protection ought to be distributed, and the advantages of the union to be shared. At present our sole endeavour is to ascertain the most effectual means which the governing power of the state can employ for protecting the rights, whatever they are, which it has seen meet to create.

Every Right imports a corresponding Obligation.

Rights, it must be remembered, always import obligations. This is a point of view, which, in the consideration of rights, has not, in general, attracted sufficient attention. If one man obtains a right to the services of another man, an obligation is, at the same time, laid upon that man to render those services. If a right is conferred upon one man to use and dispose of a horse, an obligation is laid upon other men to abstain from using him. It thus appears, that it is wholly impossible to create a right, without at the same time creating an obligation.

No Creation of Good, by Rights, without the Creation of Evil.

The consequences of this law of nature are in the highest degree important. Every right is a benefit; a command to a certain extent over the objects of desire. Every obligation is a burden; an interdiction from the objects of desire. The one is in itself a good; the other is in itself an evil. It would be desirable to increase the good as much as possible. But, by increasing the good, it necessarily happens that we increase the evil. And, if there be a certain point at which the evil begins to increase faster than the good, beyond that point all creation of rights is hostile to human welfare.

The end in view is a command over the objects of desire. If no rights are established, there is a general scramble, and every man seizes what he can. A man gets so much, and he is interdicted by the scramble from all the rest. If rights are established, he also gets so much, and is interdicted by his obligations from the rest. If what he obtains by his right exceeds what he would have obtained by the scramble, he is a gainer by the obligations which he sustains.

If it is proposed to create rights in favour of all the members of a community, the limits are strict. You cannot give all your advantages to every one; you must share them out. If you do not give equal rights to all, you can only give more than an equal share to some, by diminishing the share of others, of whom, while you diminish the rights, you increase the obligations. This is the course which bad governments pursue; they increase the rights of the few, and diminish the rights of the many, till, in the case of governments virtually despotic, it is all right on the one side, all obligation on the other.

It may be necessary to say a word, to prevent misconstruction of the term "equal rights." Rights may be truly considered as equal, if all the sorts of obligation under which a man lies with respect to other men, they are placed under with respect to him; if all the abstinence which he is obliged to practise with respect to their property, they are obliged to practise with respect to his; if all the rules by which he is bound not to interfere with their actions bind them equally not to interfere with his. It is evident, that inequality of fortune is not excluded by equality of rights. It is also evident, that, from equality of rights must always be excepted those who are entrusted with the powers of the community for the purposes of government. They have peculiar rights, and the rest of the community are under corresponding obligations. It is equally evident that those must be excepted who are not *sui juris*, as children in non-age, who must be under the guidance of others. Of two such classes of persons the relation to one another, that is, their reciprocal rights and obligations, need to be regulated by particular rules.

It is presumed that these illustrations will suffice to fix, in the minds of our readers, the exact meaning which is intended, in the present discourse, to be attached to the word *rights*. The sequel is to be occupied in discovering the means which are most proper to be employed for affording *protection* to those rights.

Meaning of the Word Protection, in the Jurisprudential Phrase, Protection of Rights

In the term protection, it is hardly necessary to give notice, that we do not here mean protection against foreign enemies; that protection which is to be yielded by employing armies against invaders. The protection, of which it is the business of jurisprudence to find out, and to describe the means, is that which is required by one member of the community against the other members. The members of the community, each of whom endeavours to have as much as possible of the objects of desire, will be disposed to take those objects one from another; to take them, either by force, or by fraud. The means of preservation are, therefore, to be found. Certain members of the community, as organs of government, are furnished with powers for that purpose. The question is, what powers are required; and in what manner are they to be employed?

In proceeding to present what may be called a sort of skeleton map of the ill-explored country of Jurisprudence, it is necessary to warn the peruser, that he must supply, by his own attention, what the limits of the work did not permit to be done for him. The several topics are rather indicated, than expounded. It is hoped they are indicated so clearly, that there will be no difficulty in spreading out the ideas in detail. It is necessary, however, that the reader should do this for himself. As the writer has not been able to dwell upon the several topics, though of the utmost importance, long enough to stamp the due impression of them upon the mind; unless the reader takes time to do this, by reflection on each topic, as it arrives, he will pass to the succeeding ones without due preparation, and the whole will be perused without interest and without profit.

The first Requisite to the Protection of Rights is to make them capable of being known.

That a man's rights may be effectually secured, it is obviously necessary, in the first place, that they should be capable of being accurately known. This seems to be so undeniable, that it would answer little purpose to enlarge in its illustration. It is, however, exceedingly necessary that the importance of this requisite should be clearly and adequately conceived. How can a man's rights be protected from encroachment, if what are his rights be uncertain or unknown? If the boundary by which his rights are distinguished is clear and conspicuous, it is in itself a protection. It warns off invaders; it serves to strike them with awe; for it directs the eyes and indignation of mankind immediately and certainly to the offender. Where the boundary, on the other hand, is obscure and uncertain, so far scope is allowed for encroachment and invasion. When the question, to which of two men an article of property belongs, comes for decision to the judge, the question is easy, if accurate marks are fixed, to point out and determine the rights of each. If no marks are attached, or such only as are obscure and variable, the decision must be arbitrary and uncertain. To that extent the benefit derived from the creation and existence of rights is diminished.

Definition of Rights, the first Instrument of Protection.

It is, therefore, demonstrable, and we may say demonstrated (the demonstration not being difficult), that, in the inquiry respecting the means of protecting rights, the *Definition of Rights* may be entered at the head of the list. Without this, as the groundwork, all other means are ineffectual. In proportion as rights can be ascertained, are the judicial functions, and judicial apparatus, capable of being employed to any beneficial purpose. In proportion to the facility with which they can be ascertained, is the extent of the benefit which the judicial functions are enabled to secure.

Such, then, is the first of the means necessary for the protection of rights. That they may receive the most perfect possible protection, they must be as accurately as possible defined.

Definition of the Acts by which Rights are Violated, and the Application of Preventive Motives, another Instrument of Protection.

In supposing that rights have need of protection, we suppose that there are acts by which rights are violated. With regard to those acts, the object is twofold; to redress the evil of the act when it has taken place; and to prevent the performance of such acts in future. To prevent the performance, two classes of means present themselves; to watch till the act is about to be committed, and then to interpose; or, to create motives which shall prevent the will to commit. It is but a small number of cases in which the first can be done; the latter is, therefore, the grand desideratum. From the view of these circumstances, we discover two other articles in the catalogue of means. Those acts by which rights are violated require to be made accurately known, in other words, to be defined; and the motives which are fitted to prevent them must be duly applied. Motives sufficient to that end can only be found in the painful class; and the act by which they are applied is denominated punishment. The definition, therefore, of offences, or of the acts by which rights are violated, and which it is expedient to punish; and the definition of the penalties by which they are

Jurisprudence.

opposed, are not less necessary than the definition of rights themselves. The reasons which demonstrate this necessity are so nearly the same with those which demonstrate the necessity of the definition of rights, that we deem it unnecessary to repeat them.

Civil and Penal Codes—What.

The definition of rights constitutes that part of law which has been generally denominated the *civil code*. The definition of offences and punishments constitutes that other part of law which has been generally denominated the criminal or *penal code*.

Code of Procedure—What.

When rights are distributed, and the acts by which they may be violated are forbidden, an agency is required, by which that distribution may be maintained, and the violators of it punished. That agency is denominated judicature. The powers, by which that agency is constituted, require to be accurately defined; and the mode in which the agency itself is to be carried on must be fixed and pointed out by clear and determinate rules. These rules and definitions prescribe the form and practice of the courts, or mode in which the judicial functions are performed; and constitute that branch of law which has been called the *code of procedure*.

Corpus Juris, or Body of Law—What.

These three codes, the civil code, the penal code, and code of procedure, form together the whole subject of jurisprudence. Of the three, it sufficiently appears, that the last exists only for the sake of the preceding. Courts and their operations are provided that the provisions of the civil and penal codes may not be without their effect. It is to be considered, therefore, as subordinate, and merely instrumental, in respect to the other two. They form the main body of the law; this is an accessary to the main body, though an accessary of indispensable use. It would be of great advantage to affix characteristic names to distinguish from one another the main and accessary parts of law. Unexceptionable names, however, it is not easy to find. Mr Bentham, the great improver of this branch of knowledge, has called the civil and penal codes together, by the name of "substantive law," the code of procedure by that of "adjective law;" not, we may be satisfied, because he approved of these names, but because the language hardly afforded others to which equal objections would not apply. In the very sense in which either the term accessary, or the term adjective can be applied to the code of procedure, both may be applied to the penal code, as it respects the civil. The penal code exists purely for the sake of the civil; that the rights, which are ordained by the legislature, and marked out by the terms of the code, may be saved from infringement. The civil code is therefore the end and object of all the rest. The code of procedure, however, is auxiliary to each of the other two; the penal code to no more than one.

Having now explained the nature of the three codes which constitute the body of law necessary for the protection of rights, it remains that we illustrate, as much in detail as our li. ✱ will permit, what is required for the perfection of each.

What is required for the perfection of the Civil Code.

The grand object of the civil code is the definition of rights. Rights are sometimes more, sometimes less extensive. Thus the right of a man to a horse may solely extend to use him in riding from one stage to another; or it may extend to the power of doing with him as he pleases. In like manner, the rights of a man with respect to a person may extend only to some momentary service, or they may go the length of slavery. Even slavery itself does not imply rights always equally extensive. In some cases, however, it implies rights as extensive over the slave as over the inferior animals.

All rights, when the essence of them is spoken of, are powers; powers to an individual which the governing members of the community guarantee; powers more or less extensive, of making either a person or a thing subservient to the gratification of a desire. To be made to gratify the desire of an individual, is to be made to render him a *service*. And this term may, fortunately, be applied to both persons and things. A man receives a service from the field when it produces a crop, as well as from the servant and the horse who ploughed it. In one meaning of the word service, it implies only active service, or that rendered by the voluntary operations of sentient beings. In the present case, however, it is employed to denote both active and passive services. It is evident, that in every case in which a being inanimate is rendered subservient to the gratification of a desire, the service is, properly speaking, a passive service. It is also evident, that even animate beings are rendered subservient to the gratification of desires in a way which may equally be called passive.

It is necessary to request attention to the explanation which is here given of the meaning in which the term *service* is to be employed; as both the English and the Roman lawyers use it in a very restricted sense. Here it is employed to denote the whole of that ministration to the gratification of our desires, which we are entitled, in consequence of rights, to derive either from persons or from things. Rights are powers, and the powers are means for the obtaining of services. We have now, therefore, a language, by the help of which we may speak with tolerable clearness.

Our object is to define rights, and rights are powers. But these powers can be defined, only by a reference to the services which they are the means of obtaining.

Operations preliminary to the Definition of Rights.

The first thing, therefore, to be done for the definition of rights is, to make out a list of all the kinds of services, which the legislature permits an individual to derive, first, from persons, and secondly, from things. This would not be a matter of very great difficulty. It would be right to begin with the most simple cases, and go on to the more complex. Thus, in the services derivable from a person, some are limited to a single species of act, and that within a limited time, and at a particular place. Others are services, consisting of various acts, limited or not limited in space and time. And lastly, are the whole services which a man is capable of rendering; without limitation as to either space or time. Considerable pains would be necessary to make the list complete; and not only considerable pains, but considerable logic would be necessary, to classify the services, in other words, make them up into lots, the most convenient for the purpose in

question; and to fix the extent of each by an exact definition. It is obvious, that as soon as all the possible gradations, in the services which one human being can render to another, are exhibited by such enumeration and assortment, it is easy for the legislature to point out exactly whatever portion of these services it is its will to give any individual a right to.

The same considerations apply to the class of things. In being made subservient to the gratification of our desires, they also render services. In proportion as a man has the right to derive those services from them, they are said to be his property. The whole of the services, which are capable of being derived from them, may, without much difficulty, be enumerated and classified; and when they are so, those which it may be the pleasure of the legislature to make any one's property, may be very easily and distinctly pointed out.

We may take land for an example. All the different services which are capable of being derived from the land may be enumerated, and, being classed under convenient heads, may be referred to with perfect certainty; and any portion of them, which is made the property of any individual, may thus be accurately described. A man may have a right simply to pasture a field; to pasture it for a day, or a year, or a hundred years. He may have a right to crop it; and that either in a particular manner, or in any manner he pleases; for a year, or for any other time. He may have a right to use it for any purpose, and that during a limited time, or an unlimited time. The services which it is capable of rendering may belong to him only in common with a number of other persons, or they may all belong to himself.

In illustration of this subject we may notice a classification of the services derivable from the land, made, though very rudely, by the English law. Blackstone, who, like other English lawyers, has on this, as on all other occasions, no idea of any other classification, than that which is made by the technical terms of the English law, has distinguished certain lots of the services derivable from the land, under the name of "Estates therein; Estates with respect to, 1*st*, Quantity of interest; 2*dly*, Time of enjoyment; 3*dly*, Number and connection of the tenants." These accordingly are, estates in fee simple, comprehending the whole of the services which are capable of being derived from the land, unlimited in point of time; estates in fee tail, implying always limitation in point of time, and often a limitation in respect to some of the services; estates for years; estates at will; estates at sufferance; estates on condition; estates in remainder; estates in reversion; estates in jointenancy; estates in coparcenary; estates in common. The Roman law has made no enumeration or classification of the services derivable from any thing, not even from the land. It speaks of property in the abstract, and in two states; property in possession, and property in action. The English law does the same thing in regard to all other property but the land. "Property, in chattels personal, is either in possession or in action," says Blackstone. He does, indeed, add, "The property of chattels personal is liable to remainders, if created by will, to jointenancy, and to tenancy in common."

Of articles of property, different from land, the services derivable from a great number need not be divided under many heads. A piece of plate, for example, may render certain services without alteration of its form; others it may be incapable of rendering without alteration of its form. It is chiefly, therefore, by limitation of time, that the various quantities of interest in such articles need to be determined. A man's right may extend to the use of a silver cup, for a day, or a year, or for his life. During this time the different services which it is capable of rendering have no occasion to be divided. They go naturally all together. An unlimited right to its services implies the power of using it, either with or without alteration of its form, and without limitation of time. In most of the instances the limited right would be called loan, though, in the case of heirlooms and some others, there is a limited use to which the term loan is not customarily applied.

In speaking of the rights which a man may have to persons; as master, as father, as husband, and so on; there is one case so remarkable, that it requires a few words to be added in its explanation. It is that of one's own person. In this case the rights of the individual have no proper limitation beyond the obligations under which he is laid, in consequence, either of the rights conferred upon others, or of the means which are thought necessary for the protection of those rights.

If we have enabled our readers to form a tolerable conception of what we desire to be accomplished, under the title of an enumeration, and commodious classification of the services derivable from persons and things, we have performed what we proposed. The enumeration and classification, themselves, are evidently incommensurate with the design of an article in the present work. That they are practicable may be confidently taken for granted. In fact, they amount to nothing more than a description of the different degrees in which the property of a thing may be possessed; a point which is decided upon in every legal dispute. If this be done, from time to time, for one article after another, it may be done once for all.

We have already said, that rights are powers, powers for the obtaining of certain services. We have also said, that those powers can be defined only by a reference to the services which they are the means of obtaining. When those services are enumerated and classified, what remains is easy. A right to these services must begin; and it must end. The legislature has only to determine what fact shall be considered as giving a beginning to each right, and what shall be considered as putting an end to it, and then the whole business is accomplished.

Two Things necessary for the Definition of a Right:— First, a Description of its Extent.

It is evident that, for the definition of rights, two things are necessary. The first is, an exact description of the extent of the right; the second is, the description of the fact which gives birth to it. The extent of the right is described by reference to the lots of services, in the title to which services, all rights consist. The facts, which the convenient

enjoyment of rights has pointed out as the fittest for giving commencement to rights, have been pretty well ascertained from the earliest period of society; and there has, in fact, been a very great conformity with respect to them in the laws of all nations.

Secondly, a Description of the Facts which give it a beginning and an End.

The following is an imperfect enumeration of them:—*An expression of the will of the legislature,* when it makes any disposition with regard to property; *Occupancy,* when a man takes what belongs to nobody; *Labour; Donation; Contract; Succession.* Of these six causes of the commencement of a right there is a remarkable distinction between the first three and the last three. The first three give commencement to a right in favour of one individual, without necessarily putting an end to a right enjoyed by any other individual. The last three give commencement to a right in favour of one individual, only by making the same right to cease in favour of another individual. When a man, by donation, gives a horse to another man, the horse ceases to be the property of the one man, by the very same act by which he becomes the property of the other; so in the case of sale, or any other contract.

It is necessary for the legislature, in order that each man may know what are the objects of desire which he may enjoy, to fix, not only what are the facts which shall give commencement to a right, but what are the facts which shall put an end to it. In respect to these facts, also, there is a great harmony in the laws of all nations.

There is first the will of the legislature. When it confers a right, it may confer it, either for a limited, or for an unlimited time. In the term unlimited time, we include the power of tradition, or transfer, in all its shapes. If the time is limited, by the declaration of the legislature, either to a certain number of years, or the life of the party, the fact which terminates the right is obvious. If a man possesses a right, unlimited in point of time, the events are three by which it has been commonly fixed that it may be terminated; some expression of his own will, in the way of gift or contract; some act of delinquency; or his death.

The possessor of a right, unlimited in point of time, may, in the way of gift or contract, transfer his right either for a limited or for an unlimited time. Thus the owner of a piece of land may lease it for a term of years. He may also, in this way, convey the whole of the services which it is capable of rendering, or only a part of them. In this transaction, one event gives birth to a right in favour of the man who receives the lease, and terminates a right which was possessed by the man who gives it; and another event, namely, the arrival of the period assigned for the termination of the lease, terminates the right of the man who had received the lease, and revives his former right to the man who gave it.

Acts of delinquency have been made to terminate rights, by the laws of most nations, in the various modes of forfeiture and pecuniary penalty.

The mode in which the event of death should terminate rights has been variously regulated. Sometimes it has been allowed to terminate them simply; and what a man left at his death was open to the first occupant. All but rude nations, however, have determined the persons to whom the rights which a man possessed without limitation of time shall pass at his death. The will of the former owner, when expressed, is commonly allowed to settle the matter. When that is not expressed, it has by most legislators been regulated, that his rights shall pass to his next of kin.

What is the extent of each right; by what event it shall receive its commencement; and by what event it shall be terminated;—this is all which is necessary to be pre-determined with respect to it. To do this is the duty of the legislature. When it is done, the inquiry of the judge is clear and simple. Does such a right belong to such a man? This question always resolves itself into two others. Did any of the events, which give commencement to a right, happen in this case? And did any of those events which terminate a right not happen in this case? These are questions of fact, as distinguished from law; and are to be determined by the production of evidence. If a man proves that an event which gives commencement to a right happened in his case, and if another man cannot prove that an event which terminates a right happened subsequently in that case, the right of the first man is established.

If we have now ascertained the importance and practicability of a civil code, and have shown what is to be done in order to obtain the benefit of it, we shall conclude, with some confidence, that we have rendered a great service to mankind. We proceed to the consideration of the penal code. The object of that code is, the acts by which rights may be violated.

What is necessary to the Perfection of the Penal Code.

In the term violation, we include all those acts by which the powers, conveyed by a right, are prevented from operating according to the will of the owner.

With respect to a part of such acts, all that it is found convenient to do, through the instrumentality of judicature, is, to remove the obstruction, which prevents the enjoyment of the right, without inflicting any penalty for creating it. Thus, if a debt is not paid when due, the right is violated of the man who ought to receive it. Enough, however, is in this case supposed to be done, if the man, by whom the debt is due, is constrained to make payment. The act of secretly abstracting, with a view to appropriate a property, perhaps, of less value, would be an act which the laws of all nations would punish as theft.

Of injurious acts, those alone, to the commission of which it has been deemed expedient that penalties should be annexed, are considered as the object of the penal code. Of injurious acts so perfect an analysis has been performed by Mr Bentham; so perfectly, too, have the grounds been laid down upon which those acts which are destined for punishment should be selected from the rest; and so accurately have the principles, according to which punishment should be meted out, been displayed by that great philosopher, that, on this part of the subject, the philosophy of law is not far from complete.

Acts meet for Punishment.

As acts are declared to be offences, and are made subject to punishment, solely for the protection of rights, it is evident, that all acts which enter into the consideration of the penal code, are acts which in-

fringe upon rights, either directly, or indirectly. Those which infringe upon rights *directly*, are those by which injury is done to some individual or individuals; a blow, for example, an act of theft, and so on. We include also, under this division, all acts the *effects* of which infringe immediately upon rights; destroying a mound, for example, to inundate the lands of another man; importation of infection, by which the health or lives of others may be destroyed. Those acts by means of which rights are affected *indirectly*, are those which bear immediately upon the means which the state has provided for the protection of rights. The means which the state has provided for the protection of rights, are the operations of government generally. All acts, therefore, meet for punishment, are acts which disturb either individuals in the enjoyment of their rights, or the operations required for the protection of those rights. The latter, though mediately, and not immediately hurtful, are apt to be more extensively mischievous than the former. An act which infringes upon a right immediately, is commonly injurious only to one individual, or a small number of individuals; an act which prevents any of the operations of government from proceeding in its natural course is injurious to all those individuals to whose protection the due course of that operation is useful. Permit acts which interrupt all the operations of government, and all rights are practically destroyed.

If, as it thus appears, acts are meet for punishment, only because they infringe upon a right, or because they interrupt the operations provided for the protection of rights, it is evident, that, in the definition of one part of those acts, must be included the specification of the right which is infringed; and, in the definition of the other, must be included the specification of the operation disturbed. Before, therefore, an accurate penal code can exist, there must exist an accurate civil code, and also what we may call a constitutional or political code; the latter consisting of an accurate definition of the powers created for the purposes of government, and of the limitations applied to their exercise.

What is required to the Definition of an Offence.

From what has been said, it may appear, that the definition of offences, by which name we shall hereafter distinguish punishable acts, consists necessarily of two parts. The first part is the specification of the right infringed, or the operation of government disturbed; and the second part is the definition of the mode. Thus, for the definition of an act of theft, the right which the act has violated must be distinctly marked, and also the mode in which the violation has been made. In the same class of offences; as those against property, for example; the mode in which the violation is performed is that chiefly which constitutes the difference between one offence and another. In a theft and a robbery, for example, the right violated may be exactly the same; the mode in which the violation was effected constitutes the difference.

For several purposes of the penal code, it is useful, that, in the specification of the right violated, the value of what has been violated, in other words, the amount of the evil sustained, should sometimes be included. It is evident, that the value of rights can be judged of ultimately, only by a reference to human feelings. Of these feelings, however, certain outward marks must be taken as the standard. In offences which concern property the modes of valuation are familiarly known. In injuries to the person, those marks which denote injuries, regarded by mankind in general, as differing in magnitude; the size, for example, or position, of a wound; in injuries to reputation, the words used, and the occasion when, and so forth, are the only means of distinction which can be employed.

It may be necessary also to remark, that, in that part of the definition which relates to the mode, are to be distinguished the parties, when more than one, who engage in the same offence with different degrees of criminality; meaning, by different degrees of criminality, nothing more than demand for different degrees of punishment. The chief classes of such persons are those of principals and accessaries; and of accessaries both those before and those after the fact.

In the definition of the mode, the act is to be described in its ordinary shape. The act, however, may be attended with aggravating circumstances on the one hand, or extenuating circumstances on the other: presenting a demand for increased punishment in the first case, and diminished punishment in the second. Mr Bentham has logically remarked, that the circumstances which are to be regarded as aggravating, and the circumstances which are to be regarded as extenuating, being pretty nearly the same in all cases, they may be defined, in a separate chapter, once for all. This being done, the code proceeds in the following manner:—The definition is given of the offence in its ordinary shape, and the appropriate punishment is annexed; then immediately follows the same offence with aggravating circumstances; punishment so much the more severe: the same offence with extenuating circumstances; punishment so much the less.

Thus far we have spoken of the definition of offences, into which we have entered the less in detail, because we do not think there is much of controversy on the subject. Many persons, who doubt the possibility of framing a civil code, though, after the preceding exposition of the subject, it is a doubt which could not, we should imagine, very easily maintain itself, allow, that offences may all be defined; and that it is possible to prevent the monstrous iniquity of punishing men for acts or offences which they have not the means of knowing to be so.

The Doctrine of Punishment.

After offences comes the consideration of the punishment to be annexed to them. This is a subject of considerable detail; it has been, however, so fully and admirably treated by Mr Bentham, that only some of the more general considerations, necessary to mark out the place and importance of the topic, need here to be introduced.

When a right has been infringed, there are two things, it is evident, which ought to be done: The injury which has been sustained by the individual ought to be repaired: And means ought to be taken to prevent the occurrence of a like evil in future.

Satisfaction.

The doctrine of Satisfaction is not at all difficult, as far as regards the regulating principles; the com-

plication is all in the detail. The greater number of injuries are those which concern property. A pecuniary value can generally be set upon injuries of this sort; though it is not very easy to determine the *pretium affectionis*, a matter of considerable importance, which the English law, so much made up of clumsiness in one part, and false refinement in another, wholly overlooks. For injuries to the person, also, it is most frequently in the pecuniary shape alone that any compensation can be made. In making these estimates, some general marks are all that can be conveniently defined by the law, and a considerable discretion must be left to the judge. Indeed, the question of damages is always a question of fact, which must be determined by the evidence adduced to the individual instance.

It accords with the feelings of every man to say, that he who has committed an injury, should be made to repair it. One part of punishment, therefore, ought, wherever special reason does not forbid, to consist in making satisfaction to the party injured. Pecuniary satisfaction, where the delinquent is rich, may be a small part of the due punishment; still, however, there is an obvious propriety, in making it a part so far as it can go. In the cases in which the delinquent has no property, there is the same propriety in making his labour subservient to that end. Hard labour, with the most economical fare, till the produce of the labour equals the amount of the satisfaction required, is, therefore, a species of punishment recommended by the strongest considerations. It is not said that labour so limited would always be sufficient punishment, and there are many cases in which it would be too much; but even then it should go as far as it can in the one case, and as far as it ought in the other.

When the injury is done to reputation, there is a manifest propriety in making the injurer contribute to the reparation, wherever it can be done. In many of the cases, too, the proper mode is abundantly obvious; all those, for example, where the publication of falsehood is the injurious act. The author of the injury may, in a way as public as that of the offence, and as well calculated as possible for the reparation of the injury, be obliged to declare that he has been solemnly adjudged to have propagated a falsehood, and is condemned to publish his own shame.

In the case of those offences which affect rights indirectly, namely, by affecting the securities provided for them, satisfaction seldom can have any place, because not any determinate individual or individuals have sustained an injury.

Thus much may suffice, in exposition of the first thing which is desirable, where an injury has been committed; namely, that reparation should be made. The second is, that measures should be adopted for preventing the future occurrence of similar events.

Punishment.

Acts are performed, only because there are motives to the performance of them. Of course injurious acts are performed, only because there are motives to the performance of them.

Corporal restraint being out of the question with regard to all the members of the community, it is evident that only two means remain for preventing injurious acts; either, first, to take away the motives which provoke to them; or, secondly, to apply motives sufficient for the prevention of them.

From the very nature of many of the acts it is impossible to take away the motives which provoke to them. From property stolen it is impossible to detach the value of the property; from vengeance it is impossible to detach the hope of that relief which is sought by the blow that is aimed.

What is wanted, then, is a sufficiency of motive in each instance to counteract the motives which lead to the crime. Whatever the motives, of the alluring kind, which lead to an act, if you give stronger motives of the same kind to abstain from the act, the act will, of course, be prevented. The man who would steal from you L.5 will assuredly not do so, if he knows that he shall receive L.6 for abstaining.

The question may then be started, Why should not all crimes be prevented in this way, since reward is much more desirable and humane than punishment? The answer is most satisfactory, and is built upon a ground which ought to receive profound attention on many occasions on which it is treated with the most perfect disregard. No reward can be given to one man, or set of men, but at the expence of some other man, or set of men. What is reward to one is therefore punishment to others. If L.6 be given to the man who would steal L.5, it must be taken from some one or more individuals of the community. If one man is elevated by any title or distinction, all the rest are with regard to him degraded and depressed. This is utterly unavoidable. The one event is necessarily included in the other. The giving of rewards, therefore, is a matter of serious consideration. It is not that simple act, that pure effusion of humanity, which it is often so fraudulently given out to be, and so credulously and foolishly admitted to be.

Other reasons, which prove the insufficiency of rewards for preventing injurious acts, are too obvious to require to be mentioned. We shall not therefore dwell upon this topic. This at least is sufficiently evident, that, to counteract the motives which lead to the commission of an act, we have but two methods. If we cannot apply motives, of the pleasurable sort, to induce the party to abstain from committing the act, we must apply such motives, of the painful sort, as will outweigh those which prompt to the performance. To prevent, by such means, a theft of L.5, it is absolutely necessary to affix to that act a degree of punishment which shall outweigh the advantage of possessing L.5.

We have now, it is evident, obtained the principle by which punishment ought to be regulated. We desire to prevent certain acts. That is our end, and the whole of our end. We shall assuredly prevent any acts, if we attach to them motives of the painful kind, sufficient to outweigh the motives of the opposite kind which lead to the performance. If we apply a less quantity of evil than is sufficient for outweighing those motives, the act will still be performed, and the evil will be inflicted to no purpose; it will be so much suffering in waste. If we apply a greater quantity of evil than is necessary, we incur a si-

milar inconvenience; we create a quantity of evil which is absolutely useless; the act, which it is the tendency of the motives of the pleasurable kind to produce, will be prevented, if the motives of the painful kind outweigh them in the smallest degree, as certainly as if it outweigh them to any degree whatsoever. As soon, therefore, as the legislator has reached that point, he ought immediately to stop. Every atom of punishment which goes beyond is so much uncompensated evil, so much human misery created without any corresponding good. It is pure unmingled mischief.

As no exact measure, indeed, can be taken of the quantity of pain which will outweigh a supposed quantity of pleasure, it is always necessary to risk going somewhat beyond the mark, in order to make sure of not falling short of it. And, in the case of acts of which the evil is very great; of the higher order of crimes, in short; it may be expedient to risk a considerable degree of excess, in order to make sure of reaching the point of efficiency.

In estimating the quantity of evil which it may be necessary to create, in order to compensate the motive which leads to a mischievous act, two circumstances should be taken into the account. These are, certainty and proximity. It is of the less importance here to enter far into the illustration of these topics, that they are now pretty generally understood. It is well known that the prospect of an evil which is to happen within an hour, or two hours, produces a much greater uneasiness than the prospect of the very same evil removed to the distance of years. Every man knows that he will die within a certain number of years: many are aware that they cannot live beyond a few years; and this knowledge produces no uneasiness. The effort, on the other hand, which enables a man to behave with tranquillity, on the prospect of immediate death, is supposed to be so difficult, that it is this which makes the hero. It is, therefore, of the greatest importance, that punishment should be immediate; because, in that case, a much smaller quantity of evil suffices. It is imperatively required, by the laws of benevolence, that, if evil is a necessary means to our end, every expedient should be used to reduce it to the smallest quantity possible. It is cruelty; it belongs only to a malignant nature; to apply evil in a way which demands a quantity of it greater than would otherwise have been required. Suppose a law, that no act of theft should be punished or challenged till twenty years after the commission, or till the life of the thief was supposed to be near its end. It is evident that all punishment, in this case; that death, in the greatest torture, would be nearly destitute of power. This is partly the ground of the complaint, of the little efficacy of religious punishment, though dreadful beyond expression in the degree.

The want of certainty is a defect of equal importance If it is a matter of doubt, whether a threatened evil will take place, the imagination is prone to magnify the chance of its not happening; and, by indulgence, magnifies it to such a degree, that the opposite chance at last excites a comparatively feeble influence. This is a remarkable law of human nature, from the influence of which even the most wise and prudent of men are not exempt; and of which the influence is predominant in those inconsiderate minds which are the most apt to give way to the allurements of vice. To illustrate this law, the influence of the religious punishments affords the most instructive of all examples. The punishments themselves go far beyond what the imagination can conceive. It is the complaint of divines, and the observation of all the world, that, with the great body of men, the efficacy of them is exceedingly small. The reason is, that to the want of proximity is added the greatest uncertainty. If a man puts his finger in the candle, he knows that he will be punished, and immediately, by being burned. If a man commits even a heinous sin, he has no fear of receiving the religious punishment immediately, and he conceives that, in the mercy of his Judge, in repentance and faith, he has a chance of escaping it altogether. This chance his imagination exaggerates, and most men can, in this way, go on sinning with tranquillity, to the end of their days. If all punishments were as certain and immediate as that of putting a finger in the candle, the smallest quantity, it is evident, beyond what would form a counterbalance to the advantage of the forbidden act, would suffice for its prevention. If uncertainty is admitted, to any considerable degree, no quantity of evil will suffice. It is a fact, which experience has most fully established, and which is now recognized in the most vulgar legislation, that undue severity of punishment runs counter to its end. This it does by increasing uncertainty; because men are indisposed to be the instruments of inflicting evil by which their feelings are lacerated. That legislation, therefore, is bad, which does not take measures for the greatest possible degree of proximity and certainty in the punishments which it applies.

The sources are three, from which motives of the painful sort, applicable to the purposes of the legislator, are capable of being drawn.—1st, The physical; 2dly, The moral; and, 3dly, The religious.

I. Pains from the physical source may be communicated to a man through,

1. His person,
2. His connections.
3. His property.

Through his person, they may be communicated in four principal ways,—by death. disablement. restraint and constraint, simple pain.

A man's connections are either public or private private, as spouse, parent, servant, master, &c.; public, as ruler, subject, teacher, scholar, and so on.

The modes in which a man is punished through his property need no explanation.

II. Pains, from the moral source, are the pains which are derived from the unfavourable sentiments of mankind. For the strength of the pains, derived from this source, we must refer to the writers who have treated of this part of human nature. It is sufficient here to advert to what is universally recognized, that these pains are capable of rising to a height, with which hardly any other pains, incident to our nature, can be compared; that there is a cer-

tain degree of the unfavourable sentiments of his fellow creatures, under which hardly any man, not below the standard of humanity, can endure to live.

The importance of this powerful agency for the prevention of injurious acts, is too obvious to need to be illustrated. If sufficiently at command, it would almost supersede the use of other means. It is, therefore, one of the first objects to the legislator to know, in what manner he can employ the pains of the popular sanction with the greatest possible effect.

To know how to direct the unfavourable sentiments of mankind, it is necessary to know in as complete, that is, in as comprehensive a way, as possible, what it is which gives them birth. Without entering into the metaphysics of the question, it is a sufficient practical answer, for the present purpose, to say, that the unfavourable sentiments of men are excited by every thing which hurts them. They love that which gives them pleasure; hate that which gives them pain. Those acts of other men which give them pleasure or save them from pain, acts of beneficence, acts of veracity, and so on, they love. Acts, on the other hand, which give them pain, mendacity, and so on, they hate. These sentiments, when the state of mind is contemplated out of which the acts are supposed to arise, are transformed into approbation and disapprobation, in all their stages and degrees; up to that of the highest veneration, down to that of the deepest abhorrence and contempt.

The unfavourable sentiments, which the legislator would excite as towards forbidden acts, must, therefore, in each man, arise from his conception of the mischievousness of those acts. That conception depends upon three circumstances; *1st,* The view which he himself takes of the act; *2dly,* The view which appears to be taken by other people; *3dly,* Every thing which operates to render more or less permanently present to his mind his own and other men's conception of its mischievousness. From these circumstances, the practical rules for applying this great power as an instrument of the legislator for the prevention of mischievous acts are easily deduced. 1. Let the best measures be taken for giving the people a correct view of the mischievousness of the act; and then their unfavourable sentiments will be duly excited. 2. Let proper pains be taken that the people shall know every mischievous act that is committed, and know its author; that, so, no evil act may, by concealment, escape the punishment which their unfavourable sentiments imply. 3. Let the legislature, as the leading section of the public, make publication of its own unfavourable sentiments; brand the act with infamy. 4. Let the same publication of his own unfavourable sentiments be made by the judge in the shape of reprimand and other declarations. 5. The legislature may increase the effect of these declarations, where the case requires it, by symbolical marks; or 6, by personal exposure. 7. The legislature may so order matters in certain cases, that the mischievous act can be done only through another act already infamous; as when it is more infamous to break a vow to God than to make false declarations to men, a witness may be made to swear that he will tell the truth. 8. As the favourable sentiments of mankind are so powerfully excited towards wealth, a man suffers in this respect when his property is so diminished as to lessen his rank.

III. In pointing and proportioning the apprehension of divine punishment the legislator can do three things:

1st, He can declare his own apprehension, and the measure of it, which should be as exactly proportioned as possible to the mischievousness of the acts:

2dly, He can hire other people to declare similar apprehensions, and to make the most of the means which are available for their propagation:

3dly, He may discountenance the pointing of religious apprehensions to any acts which are not mischievous; or the pointing of them to acts which are slightly, in a greater degree, than to acts which are deeply mischievous. Whatever power of restraining from mischievous acts may be lodged in religious apprehensions, is commonly misapplied and wasted. It would be worth the cost, therefore, of pretty forcible means to prevent such a misapplication and waste of religious fears.*

In drawing from one, or more, of all these sources, a lot of punishment adapted to each particular case, the following properties, desirable in a lot of punishment, ought to be steadily borne in view. Every lot of punishment ought, as much as possible, to be,

1. Susceptible of graduation, so as to be applicable in different degrees.

2. Measurable, that the difference of degrees may be duly ascertained.

3. Equable, that is, calculated to operate not with different intensity upon different persons.

4. Such, that the thought of the punishment may naturally excite the thought of the crime.

5. Such, that the conception of it may be naturally vivid and intense.

6. Public, addressed to the senses.

7. Reformative.

8. Disabling; viz. from crime.

* Nothing which can in any degree interfere with the rights of conscience, including whatever interpretation any man may put upon the words of Scripture, is here understood. It is the object of the legislator to encourage acts which are useful, prevent acts which are hurtful, to society. But religious hopes and fears are often applied, not to promote acts which are useful, prevent acts which are hurtful, to society; in which way, alone, they are capable of conducing to the views of the legislator; but to mere ceremonies. And cases are not wanting in which they are applied to produce acts that are hurtful, prevent those that are useful, to society. As far as religious motives are attached to the useful, instead of the useless or hurtful objects, society is benefited. It is this benefit which it is recommended to the legislator to pursue.

Jurisprudence.

9. Remediable; viz. if afterwards found to be undeserved.

10. Compensative; viz. to the party injured.

11. Productive; viz. to the community, as labour.

Of all the instruments of punishment which have yet occurred to the ingenuity of man, there is none which unites these desirable qualities in any thing like an equal degree with the *Panopticon Penitentiary*, as devised and described by Mr Bentham.

One general rule applies in the case of all the lots of punishment. It is this: That the private good which has operated as the motive to the injurious action, should, in all possible cases, be cut off, and the expected enjoyment prevented. Where this can be done completely, all the additional punishment necessary is only that which would suffice to compensate the want of certainty and proximity in the act of deprivation; for no man would commit a crime which he was sure he could not profit by; no man would steal, if he knew that the property stolen would that minute be taken from him. The interests which are capable of being promoted by a criminal act, may be summed up under the following titles:

1. Money, or money's worth.
2. Power.
3. Revenge.
4. Vanity, emulation.
5. Sensual pleasure, chiefly venereal.
6. Safety in respect to legal punishment.

With respect to four of these interests, viz. money, power, vanity, and safety in respect to legal punishment, the contemplated benefit is capable, in many cases, of being completely intercepted. In the case in which revenge has operated through the degradation of the party suffering, the evil doer may be disappointed by re-exaltation of the degraded party. Sensual pleasure, having been enjoyed, is beyond the reach of this operation. It is highly worthy of observation, that, among the advantages constituting the motives to crime, those which can be cut off, and from the enjoyment of which the offender can be prevented, constitute by far the most frequent incentives to crime.

This must suffice as a summary of what should be said on the mode of applying pain most usefully for the prevention of certain acts. It only remains to add, that the following are the cases in which it may be pronounced unfit that pain should be employed for that purpose:

1. Where the evil to the community does not overbalance the good to the individual.

2. Where the evil necessary for the punishment would outweigh the evil of the act.

3. Where the evil created is not calculated to prevent the act.

4. Where the end could be obtained by other means.

The Code of Procedure.

We have now, therefore, stated what the limits of this discourse enable us to adduce, on the subject of the main body of the law; the enactments of the legislature with respect to rights, and with respect to those acts by which rights are violated. It remains that we consider that subsidiary branch of law, by which an agency is constituted for the purpose of carrying those enactments into effect. The inquiry here is, what are the operations essential to that agency; by what agents are they most likely to be well performed; and what are the best securities that can be taken for the good conduct of these agents.

It most significantly illustrates the manner in which ignorance gropes its way in the dark, to observe, that the agency, the sole end of which is to carry into execution the civil and penal laws, was created first, and was in operation for ages, before even the idea of the other branches of law was even tolerably framed. It is also worthy of remark, that the men, whose wisdom rules our affairs, are in the habit of calling the mode in which ignorance gropes its way in the dark, by the name of experience; the mode of acting upon a plan, and with foresight, by the names of theory and speculation.

There is instruction in observing the mode in which this inverted course of law-making was pursued. Men disputed; and their disputes were attended with the most destructive consequences. Originally, the king, at the head of the military force, and his subordinates, each at the head of a section of that force, interfered in those disputes. After a time, the king appointed functionaries, under the name of judges, for that particular service. These judges decided, without any rule, by their own discretion. The feelings of the community, grounded upon their experience of what tended to good and evil upon the whole, pointed vaguely to certain things as right, to other things as wrong; and to these the judge, as often as he was in *bona fides*, conformed his decision. The mode was similar both in arbitrating and in punishing.

As punishing, especially in the severer cases, was an act which made a vivid impression upon the mind, the mode in which that act had been performed in previous cases was apt to be remembered; of the several modes, that which was most approved by the public would naturally be followed the most frequently, and at last there would be a species of scandal, if it was unnecessarily departed from. In this way a uniformity, more or less perfect, was established, in punishing the more heinous offences; and in regard to them custom first established what had some feeble portion of the attributes of a law.

In those cases in which, without a call for punishment, the authoritative termination of a dispute was all that was required, the experience of what was necessary, not only for any degree of mutual comfort, but even for the means of subsistence, soon established a few leading points of uniformity. Thus, when a man had cultivated a piece of ground, which belonged to nobody more peculiarly than to himself, it was evidently necessary that the crop should be considered as belonging to him; otherwise, no crops would be raised, and the community would be deprived of the means of subsistence.

These general feelings, with the remembrance, more or less perfect, of what had been done in similar cases, were the only guide; and it is surprising to what an extent, over the surface of the whole

globe, law has, in all ages, remained in that state of imperfect existence, if, indeed, with any propriety, it can be called a state of existence. In every part of Asia, and in all ages, law has remained in that state of existence, or non-existence. In Europe, where, at a pretty early period, it became the practice to record in writing the proceedings of the judges, the natural propensity of referring to the past as a rule for the present, begat in time a species of obligation of being directed by the examples which had already been set. This created a uniformity and certainty, which, however imperfect, were greatly superior to those which attended the arbitrary proceedings of Asiatic judges. Yet this was a benefit which had a dreadful alloy. A body, not of law, but of decisions, out of which, on each particular occasion, a law for that particular occasion, as out of the crude ore, was to be smelted, hammered, and wire-drawn, was the natural material out of which to manufacture a system of chicane. How accurately the system of law, in the several nations of Europe, has conformed to the character of a system of chicane, is matter of present and lamentable experience. The uncertainty, the delay, the vexation and expence, and that immorality of the worst species with which they inundate the community, are not the only evils, great as they are, of laws constructed upon such a plan. A system of laws, so constructed, becomes an instrument of conservation for the barbarous customs and ideas of the times in which they were engendered; and infests society with evils of another age.

To conceive the operations which are necessary to give effect to the enactments of the legislature, it is necessary to conceive the occasions which call for them.

When the legislature has established rights, so long as there is no dispute about those rights, and so long as there is no complaint of any violation of them, so long there is no occasion for any agency to give to the enactments of the legislature their effect. The moment, however, one person says, the right to that object is mine, and another person says no, but the right to that object is mine; or the moment any man complains that such or such a right belonging to him another man has violated, that moment occasion for the agency in question begins.

It is evident, also, that the operations necessary to give effect to the enactments of the legislature are confined to those two occasions, namely, that on which a right is disputed, and that on which it has been violated. On the occasions on which a right is disputed, it is requisite to determine to whom it belongs. On the occasions on which a right has been violated, it is sometimes only required to compel reparation to the injured party; sometimes it is necessary, besides, to inflict punishment upon the offender. The question is What are the operations required for these several results?

Where a right is disputed, all possible cases may be resolved into that of A who affirms, and B who denies. That right is mine, says A, it is not yours, says B.

The first question to be asked of A is, which, among those facts, which the legislature has determined shall give commencement to rights, happened in such a manner as to give commencement to that which is claimed as a right by him.

If no such fact is affirmed, the right does not exist. If some such fact is affirmed, it may be met by the opponent in one of two ways. B either may deny the fact, and affirm that the right never had a commencement; or he may allow the fact, and admit that the right had a commencement, but affirm that there had subsequently happened one of those facts which put an end to rights; admitting that A bought the horse, and had a right to him in the month of July, he might affirm that A sold him again in August, and by that transaction put an end to his right.

When B meets the affirmation of A in the first way, that is, by denying the commencement of the right, he may do it in either of two ways. He may deny the investitive fact which A affirms, or not denying the fact, he may affirm some antecedent fact which deprived it of its investitive power. Thus, if A affirmed that he got the property by occupancy, B may affirm that it was not open to occupancy, but the property of another person. If A affirmed that he got the property by succession to his father, B may allow the fact of the succession, but affirm that the property did not belong to the father of A at the time of his death.

Whenever the legislature has accurately determined what are the facts which shall give commencement, and what those which shall give termination to a right, the whole confused and intricate mass of what in English law is called *Pleading*, reduces itself to these clear and simple elements. A begins, by affirming some one of the facts which gives commencement to a right. B may deny this fact directly; A affirms contract for example, B denies it; and then, of course, comes the evidence: Or, instead of denying it, B may affirm an antecedent fact which deprived the fact affirmed by A of its investitive force; or he may affirm a subsequent fact, which put an end to the right. In those two cases, in which B affirms a new fact, A must be called upon for a reply, in other words, asked whether he admits or denies it. If he admits, there is an end, of course, to the claim of A. If he denies, then again we have affirmation and denial upon a matter of fact, which is to be determined by the production of evidence.

This is the first part of the proceeding, neither intricate nor obscure. The next is, the adduction of evidence. A fact is disputed; affirmed on the one side, denied on the other. A produces evidence to prove the fact, B produces evidence to disprove it. The decision is on the one side or the other, and the dispute is at an end.

If both parties obey the decision, there is no occasion for another act. If the losing party disobeys, force is necessary to compel obedience. This is called execution, and terminates the agency required.

It is needless to particularize a penal proceeding; all the possible varieties of which fall under one or other of the cases illustrated.

Thus, when a man is charged with a crime, the prosecutor affirms one of the acts violating rights, to which punishment is annexed by the legislator. The

defendant can meet this affirmation in one of only two ways. First, he may deny the act, and then the second stage of proceeding, the adduction of evidence, immediately takes place. Or, not denying the act, he may affirm some previous act, which prevented it from having the effect of violating a right. Not denying the fact of taking the horse out of the field with a view to appropriate him, he may affirm a previous purchase, gift, &c. The adduction of evidence has nothing peculiar in the case of a penal proceeding at law. In the last stage, that of execution, the peculiar act of inflicting punishment is required.

Having thus a view, though very summary, of the operations required, we shall be the better able to judge of the agents necessary for the performance.

The stages, we have observed, are three. The *first* is that in which the plaintiff adduces the investitive fact on which he relies, and is met by the defendant either with a denial of the fact, or the affirmation of another fact, which, to maintain the suit, the plaintiff must deny. The *second* is that in which evidence, to prove or disprove the fact on which the affirmation and denial of the parties ultimately rests, is adduced and decided upon. The *third* is that in which the operations are performed necessary for giving effect to the sentence of the judge.

First Stage of the Judicial Business.

What is desirable in the operations of the first stage is, 1*st*, That the affirmations and negations with respect to the facts should be true; and, 2*dly*, That the facts themselves should be such as really to have the investitive or divestitive quality ascribed to them. For the first of these purposes, all the securities, which the nature of the case admits of, should be taken, for the veracity of the parties. There is the same sort of reason that the parties should speak truly, as that the witnesses should speak truly. They should speak, therefore, under all the sanctions and penalties of a witness. They cannot, indeed, in many cases swear to the existence or non-existence of the fact; which may not have been within their cognisance. But they can always swear to the state of their belief with respect to it. For the second of the above purposes, namely, that it may be known whether the facts affirmed and denied are such as to possess the investitive or divestitive quality ascribed to them, two things are necessary; the first is, that all investitive and divestitive facts should have been clearly predetermined by the legislature, in other words, that there should be a well made civil code; the second is, that the affirmations and denials with respect to them should be made in the presence of somebody capable of telling exactly whether they have the quality ascribed to them or not. The judge is a person with this knowledge, and to him alone can the power of deciding on matters so essential to the result of the inquiry be entrusted.

To have this important part of the business, then, done in the best possible way, it is necessary that the parties should meet in the very first instance in the presence of the judge. A is asked, upon his oath, to mention the fact which he believes confers upon him his right. If it is not a fact capable of having that effect, he is told so, and his claim is at an end. If it is a fact capable of having that effect, B is asked whether he denies it; or whether he affirms another fact, either one of those, which, happening previously, would prevent it from having its investitive effect, or one of those which, happening subsequently, would put an end to the right to which it gave commencement. If he affirmed only a fact which could have neither of these effects, the pretension of B would be without foundation.

Done in this manner, the clearness, the quickness, and the certainty of the whole proceeding are demonstrated. Remarkable it is, that every one of the rules for doing it in the best possible manner, is departed from by the English law, and that to the greatest possible extent. No security whatsoever is taken that the parties shall speak the truth; they are left with perfect impunity, aptly by Mr Bentham denominated the *mendacity-licence*, to tell as many lies as they please. The legislature has never enumerated and defined the facts which shall give commencement, or put a period to rights; the subject, therefore, remains in a state of confusion, obscurity, and uncertainty. And, lastly, the parties do not make their affirmations and negations before the judge, who would tell them whether the facts which they allege could or could not have the virtue ascribed to them; they make them in secret, and in writing, each along with his attorney, who has an interest in making them not in the way most conducive to the interests of his client, but in the way most conducive to his own interests, and those of his confederates, from the bottom to the top of the profession. First, A, the plaintiff, writes what is called the declaration, an instrument for the most part full of irrelevant absurdity and lies; and this he deposits in an office, where the attorney of B, the defendant, obtains a copy of it, on paying a fee. Next B, the defendant, meets the declaration of A, by what is called a plea, the form of which is not less absurd than that of the declaration. The plea is written and put into the same office, out of which the attorney of the opposite party obtains a copy of it on similar terms. The plea may be of two sorts; either, 1*st*, a dilatory plea, as it is called; or, 2*dly*, a plea to the action. To this plea the plaintiff may make a *replication*, proceeding through the same process. To the replication the defendant may put in a *rejoinder*. The plaintiff may answer the rejoinder by a *sur-rejoinder*. This, again, the defendant may oppose by a *rebutter*, and the plaintiff may answer him by a *sur-rebutter*.

All this takes place without being once seen or heard of by the judge; and no sooner has it come before him, than some flaw is perhaps discovered in it, whereupon he quashes the whole, and sends it to be performed again from the beginning.

This mischievous mess, which exists in defiance and mockery of reason, English lawyers inform us, is a strict, and pure, and beautiful exemplification of the rules of logic. This is a common language of theirs. It is a language which clearly demonstrates the state of their minds. All that they see in the system of pleading is the mode of performing it. What they know of logic is little more than the name.

The agency necessary for the performance of this

Jurisprudence. stage of the business, is some person, who, when he hears a fact affirmed or denied, can tell whether it is one of those facts to which the legislature has attached the power of giving commencement or of putting a period to rights. It is evident, that on such occasion, any one person, with the requisite knowledge, attention, and probity, is as competent to the task as a hundred. If he is single, the attention and probity is likely to be the greatest, as responsibility is not weakened merely, it is almost annihilated by being shared. There should be one Judge, therefore, and not more, to superintend that branch of procedure which consists of pleading.

Second stage of the Judicial Business. The agency best adapted to the business of the second stage of judicature, is that which next demands our attention. The business of that stage is, the taking of evidence; in other words, the doing all that is necessary to ascertain whether the disputed fact happened or did not happen.

The subject of evidence is a matter of complexity in the detail. And where any thing complex is to be stated in words, there is always difficulty in the expression, how plain soever the ideas. Such general considerations, however, as we can even here adduce, will, we hope, throw sufficient light upon the subject, to leave no doubt with respect to the conclusions which we have it in view to establish. This is one of the topics, connected with law, which Mr Bentham has exhausted, though a small part only of what he has written upon it has yet seen the light.*

With respect to all facts, legally operative, that is, which give or take away rights, it is desirable that evidence, amounting to proof, should, if possible, always exist. With respect to a great proportion of them, it is in the power of the legislature to take measures, that evidence of them shall be collected at the moment of their happening, and shall be preserved. This is the case with all those of which an evidentiary writing can be made and preserved by registration; all contracts, births, deaths, marriages, and so on. The proportion is really very great of the whole number of facts, legally operative, in regard to which a legislature, by proper means, might secure the existence of evidence, and to that extent might either prevent disputes, or render the decision of them easy. That so little of this most important and obvious work has any where been done, only shows how ill the legislatures of the world have hitherto performed the task. It is in the power of the legislature, by a proper classification, to have an accurate formulary, for the different species of *contracts*, *wills*, and other *evidentiary writings*. Those formularies, properly made and printed with blanks to fill up, would render the business of *Conveyancing*, which, in England, is a boundless, trackless, and almost impenetrable jungle, abounding with expence, with delay and vexation to parties, with wealth and almost boundless power over the fortunes of other men to lawyers, a thing of the greatest simplicity, certainty, and ease.

Into the question of what might be, and ought to be done by the legislature, for making and preserving evidence of the principal facts by which rights are made to begin or to end, we cannot enter at length, on the present occasion. The great importance which belongs to the subject, is evident from what we have thus shortly advanced.

The business of him who is only called upon to determine whether a disputed fact did or did not happen, is, to make the best use of all the evidence which exists; whether it were, or were not desirable, that more had been made to exist. For the best use of that which exists, three things are necessary:

1*st*, That the whole of it should be made to bear, that is, should be taken and applied.

2*dly*, That it should be taken in those circumstances, which are most conducive to trust-worthiness.

3*dly*, That the proper value should be set upon each article, and upon the whole.

1. That the evidence may be taken as completely as possible, two things are necessary. The first is, that the judge should have power to send for, and to compel the attendance of, all persons and things which may be capable of affording evidence. The second is, that the evidence should all be taken, and nothing be omitted or lost.

It is not necessary here to enter into any details with respect to the first of those requisites. The necessity of the powers is obvious, and the end to be attained is so precise and perspicuous, that there can be no difficulty in conceiving the mode of putting together and applying the means. There is no limit, it is obvious, to the physical power which should be placed at the disposal of the judge. He ought to have the right of calling upon every man, upon the whole community, to aid him in any act which is necessary to the performance of any part of his judicial duty; because any force, opposed to the performance of that duty, there ought to be a force sufficient promptly to overcome. It is convenient, however, to the community, instead of being liable to be called upon, individually, for the performance of the ordinary services auxiliary to the business of the judge, to provide him with a proper number of officers, paid for attending to execute his commands. Their principal business, as regards this stage of the judicial proceedings, is, to serve notice upon any persons whose own presence, or that of any writing or other thing which they may possess, is required by the judge. Persons or things, subjected immediately to the operations of judicature, have a particular name in English. They are said to be *forthcoming*, a word which has an exact equivalent in few other languages, and is exceedingly appropriate and useful. It is of the greatest convenience, when a concrete term, the use of which is very frequent, has an abstract term corresponding to it; as good, has goodness; hard, hardness, and so

* We are happy to say, there are hopes that this part of Mr Bentham's writings will soon be presented to the public by M. Dumont, the first of translators and redacteurs, in that happy form which he has given to other portions of that philosopher's manuscripts.

on. There was not any word in the language corresponding in this way to *forthcoming*. Mr Bentham, perceiving the great need of it, made the term *forthcomingness*; not exceptionable on the score either of harshness or obscurity. The small wits thought proper to laugh at him. We shall, nevertheless, sorry at the same time that we cannot supply a defect in the language without offending them, make use of the word, in which we find great appropriateness and great convenience. This particular branch, therefore, of the judicial agency is that which relates to *forthcomingness*; and forthcomingness is required for two purposes, both for evidence and for justiciability; for evidence, that a true decision may be passed; for justiciability, that the sentence of the judge may not fail of its intended effect.

So much with respect to the forthcomingness of evidence. The second condition, required to give the decision the benefit of all the existing evidence, is, that the whole should be taken, and that not any part of it which can be taken without preponderant inconvenience should be excluded and lost.

Of the several articles of evidence, some will always be of more importance; some of less; and some may be of very little importance; but whether of little or of much, it is always desirable that all should be taken, and every the smallest portion counted for what it is worth. The discovery of truth is promoted by taking advantage of every thing which tends to throw light upon the subject of dispute.

These propositions, it may appear to be useless, indeed impertinent, formally to state. They are too evident, it may be said, to be disputed, and too important to be overlooked. Important as they are, and undisputed by all the rest of the world, they are not only disputed, but trampled upon by lawyers, especially English lawyers. They have unhappily established a set of rules in direct opposition to them. These rules they applaud in all forms of expression, and celebrate as guards and fences of all that is dear to mankind.

In all causes, they have determined, that persons so and so situated, things so and so situated, though apt to be pregnant with information beyond all other persons and things, shall not be admitted as sources of evidence. Thus, in English law, we have incompetency of witnesses, that is, exclusion of them, 1*st*, From want of understanding; 2*dly*, From defect of religious principle; 3*dly*, From infamy of character; 4*thly*, From interest. These are undisguised modes of exclusion; besides which, there is an extensive assortment of disguised modes. Under this title comes the rule, that only the best evidence be given which the nature of the case admits of; according to which, it often happens that the only evidence which can be had is excluded. Under this title also falls the rule, making certain kinds of evidence conclusive, by which proceeding, all other evidence is excluded. To the same list belongs the rule, that hearsay evidence is not admissible. The rules, so extensive in their application, by which writings are wholly rejected, only because they want certain formularies, are rules of exclusion; and so are the limitations with respect to time, and to number of witnesses. Into the very extensive subject, however, of the absurdity and mischievousness of the rules of evidence in English law, we cannot pretend so much as to enter. A remarkable exemplification of them was afforded on the trial of Warren Hastings, to which, for this purpose, the reader may be referred. (See Mill's *History of British India*, Book VI. Chap. ii.)

The only conceivable reasons for the exclusion of evidence are three:

1. Irrelevancy.
2. Inconvenience in obtaining and producing.
3. Danger of deception.

With regard to irrelevancy, the decision is clear. What has no tendency either to prove or disprove the point in question, it would be loss of time to receive.

With regard to inconvenience, it is no doubt liable to happen, that when all the good which can be expected from the obtaining of a lot of evidence is compared with the evil of the delay, cost, and vexation, inseparable from the obtaining of it, the evil may be more than an overmatch for the good. In all such cases, it is expedient that the lot of evidence should be foregone.

As a guard against the danger of deception, it is equally certain that no evidence ought ever to be excluded. An account of all the reasons by which the absurdity is demonstrated of exclusion on this ground, and of the wide and deplorable mischief which, in the vulgar systems, is produced by it, would be far too extensive for the contracted limits of the present discourse. Reasons, however, decisive of the question, present themselves so obviously, that hardly any man, with an ordinary understanding, not fettered by prejudice, can look at the subject without perceiving them.

If evidence is to be received from no source from which evidence, liable to produce deception, is capable of coming, evidence must not be received at all. Evidence must be received from sources whence false evidence, as well as true, is liable to flow. To refuse all information from such sources, is not the way by which a knowledge of the truth can be obtained. This is the way to make sure of not having that knowledge. The means of obtaining it are, to receive information from every possible source, and to separate the bad from the good, under all those securities, and by the guidance of all those marks, of which understanding and attention know how to avail themselves.

It is not enough to say, we will receive information from those sources only which are least likely to yield deceptious evidence, refuse to receive it from those which are most likely. You are obliged to receive it from sources differing in almost all possible degrees of likelihood. Where are you to draw the line of separation? Is not the same discernment which guards you against the danger of false information from the sources which you deem the least likely to yield it, sufficient to guard you against it from those sources which you deem the most likely to do so? In fact it will be still more sufficient, because in this case you will be much more apt to be upon your guard. The very best information is, in truth, liable to be derived from the very worst of

sources,—from a man who, you know, would not tell you one word of truth, if he could help it.

The securities that a man will give true information, independently of those artificial securities which the legislature can apply equally to all, are, 1*st*, Intelligence. 2*d*, Probity. 3*d*, Freedom from interest. Suppose that one or two, or all of these securities are wanting; it only follows that what he states should be heard with a proportional distrust. It may still be of the utmost importance to the discovery of the truth that he should be heard. It never can be less than unfavourable to that great end that, with the proper allowances, he should not be heard at all. His testimony may appear, when heard, to be utterly unworthy of credence. But that could not be known till it was heard and examined. It might so have been, that it was not only worthy of credence, but completed the proof of a fact of the greatest possible importance. That a man should not be heard as a witness, on account of his religious creed, is an absurdity which we cannot descend to notice.

2. The second of the three things which we found necessary, as above, for making the best use judicially of whatever evidence, to the fact in question, exists, was, that it should be taken under those circumstances, which are most conducive to trust-worthiness. Those circumstances are constituted by the artificial securities, which arrangements can be made to apply. The following enumeration of them has been made by Mr Bentham (*Introduction to the Rationale of Evidence*, p. 54), and appears to be complete.

1. Punishment.
2. Shame.
3. Interrogation, including counter-interrogation.
4. Counter evidence,—admission of.
5. Writing,—use made of it for giving permanence, &c. to evidence.
6. Publicity,—to most purposes and on most occasions.
7. Privacy,—to some purposes, and on some occasions.

For developing the import of these several securities, we can afford to say nothing. The principal operation of the judicial functionary in this part of the business is, to preside over the interrogation; to see that it is properly and completely performed. The question, then, what is the sort of agency best adapted for the performance of this part of the task of taking evidence, is not difficult to answer. There is nothing in it which one man, with the proper intellectual and moral qualifications, is not as capable of performing, as any number of men.

3. All the existing evidence being collected and received, it only remains that the proper value should be attached to the several portions, and a corresponding decision pronounced.

It is sufficiently evident that, for the performance of this duty, no very precise instructions can be laid down. The value which belongs to an article of evidence often depends on minute and almost indescribable circumstances; and the result must be left to the sagacity and conscience of the judge.

At the same time, however, service to this end, and of the greatest importance may be, and, of course, ought to be, rendered by the legislature. The different marks of trust-worthiness may, to a certain extent of particularity, be very correctly described. This being done, the difference between the value of any two lots of evidence, to which those marks attach, may be very exactly ascertained. One has a certain number of the marks of trust-worthiness, as laid down by the legislature; another has all these and so many more; the result is clear. It is evident, that as far, in this respect, as experience and foresight can go, nothing should be left undone by the legislature.

Another important service can be rendered by the legislature; and that is, to provide an accurate language for the judge; a language in which he can express precisely the degree of value which he allots to each article of evidence, and to the whole. Various expedients may be adopted for this purpose. A very obvious one is, to fix upon some particular, well known article of evidence, the value of which all men appreciate equally; the clear testimony, for example, of a man of the ordinary degree of intelligence and probity; as a standard. Is the value to be expressed, which the judge attaches to any other article of evidence? If inferior to the standard, it falls below it by so many degrees, one, two, three, four: If superior, it rises above it by so many.

Having provided an accurate language, the legislature should take security that it be used; and admit of no vague and general expressions in the account of the value which the judge attaches to each article of the evidence on which he grounds his decision.

At the same time that the legislature insists upon the use of precise language in stating the value of evidence, it should insist upon reasons; upon receiving from the judge a precise statement of the grounds upon which he attaches such a value, and no other, to each and every article of evidence; that is, upon receiving a reference, as exact as language can give, to each of the circumstances which contributed to suggest to him that particular estimate which he says he has formed.

Of the importance of all these expedients we presume that no illustration is required.

Third stage of the Judicial Business.

We come now to the third and last stage of the business of judicature; when all that remains is to carry into effect the sentence of the judge.

When they, upon whom the sentence operates, are willing to obey, all that is necessary is to afford them notice of what it requires them to perform. In well ordered countries, all but a very insignificant number will be found to be cases of this description. When opposition is to be overcome, a physical force must be provided, sufficient for the purpose. As there seems nothing mysterious in determining how this should be formed, and under what rules it should act, to secure the ends for which it is provided, with the smallest possible amount of collateral evil; we shall here take leave of the subject.

We have now seen the whole of the operations to be performed. The parties are received to state before the judge the investitive or divestitive facts on

which they rely. If they state, for this purpose, a fact which is not possessed of those qualities, they are immediately told that it is not possessed of them, and not calculated to support their claim. They come, by two or three steps, at the longest, to a fact upon which the question ultimately turns; and which is either contested, or not contested. In a great many cases it would not be contested. When the subject was stript of disguise, the party who had no right, would generally see that he had no hope, and would acquiesce. The suit would thus be terminated without the adduction of evidence. When it was not, the cases would be frequent in which it might be terminated by the evidence which the parties brought along with them. In these cases, also, the first hearing would suffice. A vast majority of the whole number of suits would be included in these two sets of cases. For the decision of a vast majority, therefore, of the whole number of suits, a few minutes would suffice. When all the evidence could not be forthcoming at the first hearing, and only then, would a second hearing be required. In this mode of proceeding, justice would be, that without which it is not justice, expeditious and cheap.

The Judicial Establishment; or inquiry what the ...y of ...ncy ... for ... effect Laws.

In all this there is nothing which one man, with the appropriate intellectual and moral qualities, is not as competent to perform as any number of men. As one man is cheaper than any greater number, that is one reason why no more than one judge should be allowed to one tribunal.

The next object of inquiry is, to ascertain what securities can be provided that those who are entrusted with the business of judicature shall possess the requisite intellectual and moral endowments.

...curities for the intellectual endowments of the Judg...

The intellectual endowments depend upon those who have the power of choosing and of dismissing the judges; and who do or do not appoint men whose knowledge and capacity are ascertained. The moral behaviour of the judges depends upon the interests which act upon them in the situation in which they are placed.

Into the question, who should have the appointment of the judges, we do not intend to enter. The answer would be different under different forms of government; and this is not the place to compare the different forms of government, either for this or any other of the ends of its institution. One thing only we shall state, because it carries its evidence along with it. Those who appoint the judges ought to have no interest contrary to the best administration of justice.

S... for the moral Qualities of the Judge

As the uprightness of the judge is assailed by interests inseparable from his situation; viz. the profit which he may derive from misdecision, it is necessary to counterbalance them by opposite interests, assuming the character of securities. Several of the securities, which we have already seen applying to the situation of witness, apply also to the situation of judge: Some are peculiar to each. The following is the list of those which apply to the situation of judge.

1. Punishment.
2. Shame.
3. Publicity.
4. Writing, for the sake of accuracy and permanence.
5. Singleness of the functionary.
6. Appeal.

For the *Punishment* of the several kinds of judicial offences, provision ought to be made in the penal code.

In the case of the judge there is particular occasion to point accurately, and to strengthen to the utmost the operation of *Shame;* for in the situation of judge it is possible to be guilty of offences very numerous and very serious, without permitting so much of evidence to attach to any definite act, as would suffice to form a ground for punishment.

The great instrument for the application of shame is *Publicity.* The importance of publicity, therefore, is paramount. It is not only the great instrument for creating and applying the moral sanction, the approbation and disapprobation of mankind; but it is of essential service towards the application of punishment, by making known the occasions on which it is deserved. It is not only a great security in itself, but it is the principle of life and strength to all other securities.

All other publicity is feeble and of little worth compared with that of the *Press.* Not only, therefore, ought this to be allowed to operate with its utmost force upon the judge, but effectual provision ought to be made to cause it to operate upon him with its utmost force. Not only ought the judgment hall to be rendered as convenient as possible for the reception of the public; not only ought the greatest freedom to be enjoyed in publishing the proceedings of the judge: and in publishing all manner of observations upon them, favourable or unfavourable; but measures ought to be taken to make a public, and to produce publication, where there is any chance that a voluntary public, and voluntary publication, would be wanting. For this purpose, unless other very important considerations intervene, the judgment seat should always be in that place, within the district to which it belongs, where the most numerous and intelligent public, and the best means of publication, are to be had

In England, where there is no definition of libel, and where the judges, therefore, are allowed to punish, under the name of libel, whatever writing they do not like, the publishing of unfavourable observations on the conduct of a judge; nay, in some instances, and these the highest in importance, the simple report of his proceedings—is treated as one of the most heinous of all possible offences. No wonder! Allow judges, or allow any men, to frame laws, and they will frame them, if they can, to answer their own purposes. Who would not, if he could, make a law to protect himself from censure? More especially if he were a man disposed to act in such a way as to deserve censure?

Would you allow falsehood to be published against the judge? The word falsehood is here ambiguous. It means both erroneous opinions, and false statements with regard to fact. Erroneous opinions we would undoubtedly permit, because we know no standard for ascertaining them, other than that which is afforded by public discussion; and be-

cause this is an adequate remedy for all the evil which erroneous opinions have any tendency to produce. Affirmation of facts injurious to the judge, if false, and made without reasonable grounds for having been believed to be true, we would prevent.

Allow facts, injurious to the judge, to be published, even when true; allow comments, unfavourable to the judge, to be made upon his actions, you discredit the administration of justice. Discredit the administration of justice, to which the people are resorting every day for the greatest of all possible benefits, protection from injury! As well talk of discrediting the business of a bread-baker, a meat-seller, if the fraudulent dealer is exposed to the censures of the public! Discredit the administration of justice, indeed, by taking measures of security against the vices of judges; indispensable for its perfection!

The importance of *recording, in permanent characters*, what takes place before the judge, we must content ourselves with assuming. We may do so, it is presumed, with propriety, on account of the facility with which the reasons present themselves. We must also leave it to our readers to draw the line of distinction between the occasions on which it is requisite, and the occasions on which it may be dispensed with; the occasions, for example, where every thing is simple and clear, and all parties are satisfied.

It is a great security, both for diligent and for upright conduct in the judge, that he occupy *singly* the judgment seat. When a man knows that the whole credit and reward of what is done well; the whole punishment and disgrace of what is done ill, will belong to himself, the motive to good conduct is exceedingly increased. When a man hopes that he can shuffle off the blame of negligence, the blame of unfairness, or fix a part of it on another, the uncertainty of the punishment operates, as we have already seen, to the diminution, and almost to the extinction, of its preventive force. Certain common, and even proverbial expressions, mark the general experience of that indifference, with which a duty, that belongs in common to many, is apt to be performed. What is every body's business is nobody's. This is as true in the family as in the state; as true in judicature as in ordinary life. Much remains to be said upon this topic, which is one of great importance; but we must pass to the next.

Of the use of *appeal*, as a security against the misconduct of the judge, there is the less occasion to adduce any proof, because it seems to be fully recognised by the practice of nations.

One thing, however, which is not recognised by that practice, is, that, if it is necessary in any one sort of causes, so it is in every other, without exception. Not a single reason can be given why it should exist in one set of cases, which is not equally strong to prove that it should exist in any other.

It is instructive to observe the cases in which it has been supposed that it ought to exist, and the cases in which it has been supposed that it might be omitted. The cases in which it has been thought necessary, are those which concern property of considerable value. Those in which it has been dispensed with are those which concern property of inconsiderable value. The first set of cases are those which are of importance to the aristocratical class; the second are those which are of no importance to that class. It is the aristocratical class who have made the laws; they have accordingly declared that the suits which were important to them should have the benefit of appeal; the suits not important to them should not have the benefit of appeal.

We recognise only one standard of importance; namely, influence upon human happiness and misery. The small sum of money for which the suit of the poor man is instituted is commonly of much greater importance to him, than the larger sum for which the suit of the rich man is instituted is to the rich. Again, for one rich man there are thousands and thousands of poor. In the calculation, then, of perfect benevolence, the suits for the small sums are not as in the calculation of perfect aristocracy, those of the least, or rather no importance; they are of ten thousand times greater importance than the suits for the largest sums.

If an appeal ought to be had, how many *stages* should there be of appeal? This question, we imagine, is easily answered. If you go for a second judgment, you should, if possible, go to the very best source; and if you go at once to the best source, why go any farther?

What is required to be done, in the case of an appeal, is the first thing which deserves to be ascertained. An appeal takes place in consequence of a complaint against the previous judge. Where no complaint, there is no appeal, nor place for appeal.

A complaint against the judge must relate to his conduct, either at the first, the second, or the third stage, of the judicial operations.

If to his conduct at the first stage, it must be a complaint of his having permitted a party to rest upon a fact which had not the investitive or divestitive quality ascribed to it; and this implies either a mistake with respect to the law, or that he allowed the decision to turn upon a fact which did not embrace the merits of the question. It is evident, that for the decision of this question, all that is necessary is an exact transcription of *the pleadings*, and transmission of them to the court of appeal.

If the complaint relates to his conduct at the second stage, it must turn upon one of two points; either that he did not take all the evidence, or that he did not properly determine its value.

If he did not take the evidence properly, by a failure either in assembling the sources of it, or in extracting it from them when assembled, the proper remedy is to send back the cause to him, with an order to him to supply the omission; or, if he be suspected of having failed wilfully, to send it to the judge of one of the neighbouring districts, to retake the evidence and decide.

If the complaint relates to a wrong estimate of the evidence, the statement of it transmitted to the court of appeal, with the reasons assigned by the judge for the value affixed to every portion of it, will enable the appellate court to decide.

With regard to the third stage, the only com-

plaint there can be is, that the judge has not taken measures to execute his own sentence. If any inquiry is in this case to be made, the proper course is, that the appellate court refer it to one of the neighbouring judges. When a simple act is to be done, the proper order is to be dispatched, and the proper penalties for non-performance exacted.

It thus appears, that for every thing which is required to be done by the appellate judicature, nothing whatsoever is required, as a foundation, but certain papers. The presence is not required, either of parties or of witnesses.

As it is of no great consequence, in a country in which the means of communication are tolerably provided, whether papers have to be transmitted 50 or 500 miles, the distance even though considerable, of the seat of the appellate jurisdiction is a matter of very little importance. The object, then, is to get the best seat that is, the best public. The best public, generally speaking, is in the capital. The capital, then, is the proper seat of all appellate jurisdiction. And that there should be one judge, and one judge only, in each court of appeal, is proved by exactly the same reasons, as those which apply to the courts of primary jurisdiction.

The question how many courts there should be, as well of primary as of appellate jurisdiction, is to be determined by one thing, and one thing only; namely, the need there is for them. The number of the courts of primary jurisdiction must be determined, in some instances, by the number of suits; in some, by local extent. To render justice sufficiently accessible, the distance from the seat of judicature must not be great, though the number of accruing suits, either from the paucity or from the good conduct of the people, should be ever so small.

As the judgment seat should never be empty, for the need of staying injustice is not confined to times and seasons, and as one judge may be sometimes ill, sometimes called to a distance even by the duties of his office, provision ought to be made for supplying his place. For this purpose the proper expedient is a deputy. That the deputy should well perform his duty, the best security is, that he should be chosen and employed by the judge, the judge being responsible for the acts of the deputy as his own. Whatever it is which the judge cannot do, or cannot conveniently do, in that he may employ his deputy. If there is a great influx of causes, the deputy may be employed in some of those the least complex and difficult. If there is any business, not of first rate importance, requiring the presence of the judge at a distance, the delegation of the deputy or deputies is the proper resource.

Besides the judge and his deputy, there are two adjuncts to every tribunal, which are of the utmost importance; indispensable, indeed, to the due administration of justice. These are a *pursuer-general* and a *defender-general.* The business of both pursuer-general and defender-general is to reclaim the execution of all laws in the execution of which the nation has a peculiar interest, though individuals may not. The peculiar business of the pursuer-general is to act on behalf of the administrative authority, in its character of plaintiff, and on behalf of every plaintiff who is without the means of engaging another advocate; to obviate any prejudice he sees likely to arise to justice from the conduct of plaintiffs, whether in civil matters or penal; and to perform in the case of all offences, where no private prosecutor appears, the office of prosecutor. The peculiar duty of the defender-general is to act on behalf of the administrative authority in its capacity of defendant, and on behalf of every defendant who has not the means of engaging another advocate, and to obviate any prejudice he sees likely to result to justice from want of skill or other causes on the part of a defendant who pleads his own cause, or on the part of him who pleads it for him.

The courts of appeal, though all seated in the metropolis, ought to be as numerous as the speedy hearing of all the appeals which come to them requires. The judges of appeal ought all to be chosen from the judges of primary jurisdiction, not only on account of the education and the experience received, but as a step of promotion, and a proper motive to acquire the requisite education, and to merit approbation in the inferior employment. There is the same propriety, and for the same reason, in choosing the judges of primary jurisdiction from the deputies. (F. F.)

JUSSIEU (Antoine de), M. D. Professor of Botany in the Royal Garden at Paris, and a member of the *Academie des Sciences*, was born at Lyons in 1686, and educated at Montpellier, where he received his degree of Doctor of Physic, being afterwards associated with the faculty of Paris.

Although much occupied in the practice of medicine in the capital, he was ardently devoted to the study of botany, having, in the early part of his life, visited Spain and the southern provinces of France in search of plants. When stationary at Paris, he communicated various essays to the Academy, which are printed in its *Mémoires.* These are chiefly botanical, illustrating the characters or the qualities of various exotics, at that period not well known; but he has given several papers also, on extraneous fossils, and a few other subjects of natural history. He furnished the two *Appendices* to Tournefort's *Institutiones Rei Herbariæ*, and edited the *Icones* of Barrelier. He also published a historical account of the magnificent collection of drawings of plants of animals, originally begun under the auspices of Gaston Duke of Orleans, and continued down to the present times.

When Linnæus visited Paris in 1738, he, in a letter to Haller, mentioned this, the elder, Jussieu, as "much engaged in medical practice, well versed in the knowledge of the species of plants, though too prone to multiply them, and strictly confined to the

ideas and principles of Tournefort.' In one important point, however, which could hardly escape Linnæus, and ought not to be forgotten, he emancipated himself from the errors of his master, for he perfectly understood, and fully admitted, the doctrine of the sexes of plants. A letter of his, completely explaining this phenomenon, on the most correct principles, is given by Bradley, in his *Philosophical Account of the Works of Nature*, p. 25-32.

He died of an apoplectic fit, at Paris, April 22, 1758, aged 72. (J. J.)

JUSSIEU (Bernard de,) younger brother of the preceding, and like him a Physician, and a member of the *Academie des Sciences*, was still more devoted to the philosophical as well as practical study of botany, and ranks among the greatest names in that science, as having first attempted to form a system, according to the *natural affinities of plants*. He was born at Lyons in 1699, and appears to have accompanied, or followed, his brother to Paris, where he occupied, under him, the place of botanical demonstrator, in the *Jardin du Roi*, and at length succeeded him as Professor of Botany. If his communications to the Academy were less numerous than those of his brother, they were of a rather superior character. In one of them, published in the *Mémoires* of that body for 1742, he enters on the subject, then scarcely touched by any person, of the animal nature of certain marine productions, previously taken for plants; and we perceive in his inquiries, dawnings of that meridian light, which our countryman Ellis afterwards threw on these curious tribes. On other occasions he explained the flowers of the *Littorella*, and, with much acuteness, the more obscure fructification of the *Pilularia*. He wrote, in conjunction with the learned Comte de Caylus, on the *Papyrus*, and he gave an improved edition of Tournefort's *History of the Plants about Paris*, in 1725.

Linnæus became personally acquainted with this ingenious man at Paris, in 1738, and maintained, for some years, an intimate correspondence with him. They could not be long in each other's company without discussing the natural affinities of plants, a study which seems to have been much advanced, if not first excited, in the mind of Linnæus, by his correspondence with Haller. Bernard de Jussieu had, about the same time, by his own contemplations, probably, been led to consider it; for the system of Tournefort, in which he was educated, is too artificial in principle to have given him any such ideas. In its execution, indeed, that great author is led, by his own good sense, into some natural and philosophical views, in spite of his system; and these may possibly have caught the attention of Jussieu. However this may be, mutual satisfaction, and reciprocal instruction, could not but flow from the converse of Bernard de Jussieu and Linnæus. They traced out together the characters and the limits of various natural assemblages, or orders. Every day produced, and every letter communicated, some new discovery. But as the multifarious hordes of the north appear originally to have used one common tongue, which, after they were dispersed, divided, and cultivated, when it came to be written, assumed the form of various distinct languages, so these two botanical philosophers, when their more intimate intercourse had ceased, pursued different paths, and went far towards different conclusions. Linnæus, after throwing the whole vegetable creation, more or less completely, into natural groupes, became more and more persuaded, that it was not only impracticable to connect them by one synoptic clue, or system, but that not one of his assemblages, or orders, was capable of precise and unexceptionable definition. On the other hand, Bernard de Jussieu, to the last, aimed at a general scheme of classification, though he accomplished little more than throwing his several orders into larger assemblages, and disposing the whole, as indeed Linnæus himself has done, in one series, according to their relationship to each other. The French botanist is recorded to have spoken with great diffidence of his own performance, and has written nothing of a general classification. But he often gave hints, in lectures or conversation, by which others perhaps have profited. This appears from the preface to the *Genera Plantarum* of his distinguished nephew, Antoine Laurent de Jussieu, the present Botanical Professor at Paris, who, following up the ideas of his uncle, and sacrificing something to technical convenience, at the expence of nature, has contrived to exhibit a tolerably natural system, founded on methodical principles.

It would be to little purpose to discuss, at the present day, the claims of Linnæus or of Bernard de Jussieu to originality in the study of natural orders. Professor De Candolle has justly asserted, that they had the same object in view, and adopted, in the main, the same principles. B. de Jussieu, in a letter, dated February 15, 1742, congratulating Linnæus on his appointment to the botanical chair at Upsal, says, "*Floræ devotus omninò poteris viam quam monstrasti facilem amplius aperire, naturalemque methodum tandem perficere, quam desiderant et expectant botanophyli omnes.*" In a subsequent letter of May 7, 1746, he tells his Swedish friend, "*Scio quantum emolumentum receperint qui secundum tua principia student; memet experientia docuit.*" This is enough to settle the question, though great allowance is, perhaps, due to the modesty of Jussieu, who was less disposed to honour himself than his friend.

His biographer, the celebrated Marquis de Condorcet, records his singularly amiable and unaffected manners. These, during his occupation of arranging, according to natural classes, the garden of Trianon, attracted the notice and esteem of his sovereign, Louis XV. to whom any unsophisticated character, or object, could not but form an agreeable relaxation from the routine of a court. Jussieu obtained plants and seeds to be sent to his friend in the king's name. He pursued his innocent and useful studies till his death, which happened in 1777, in his 79th year.

A compendious view of his nephew's system, and a comparison of their Natural Orders with those of Linnæus, may be seen under the article Botany, in the second volume of this *Supplement*. (J. J.)

Kaleidoscope.

KALEIDOSCOPE, an optical instrument, invented by Dr Brewster, which, by a particular arrangement of mirrors, or reflecting surfaces, presents to the eye, placed in a certain position, symmetrical combinations of images, remarkable for their beauty and the infinite variations of which they are susceptible. The name is derived from the Greek words καλος, *beautiful*, ειδος, a *form* or *appearance*, and σκοπεω to *see*.

History of the Invention of the Kaleidoscope.

The effect of combining two or more plane mirrors, so as to produce a multiplication of images, had long been known and described by writers on optics. Baptista Porta, in his *Magia Naturalis*, gives an account of the construction of an instrument, which he calls *polyphaton*, in which two rectangular specula are united by two of their sides, so that they may be opened or shut like a book, and the angles varied; and also of a polygonal speculum, consisting of several mirrors arranged in a polygon, for multiplying in different directions the images of objects. Kircher, also, in his *Ars Magna Lucis et Umbræ*, describes, as an invention of his own, the former of these constructions, and distinctly traces the relation between the angle of inclination of the mirrors, and the number of images formed. The very same contrivance was afterwards adopted by Bradley for the purpose of assisting in the designing of garden plots and fortifications; and he states that, "from the most trifling designs, we may, by this means, produce some thousands of good draughts." But the particular application of this principle in the case where the two reflectors are inclined to one another at a small angle, so as to form a series of symmetric images, distinctly visible only in a particular position of the eye, was a discovery reserved for Dr Brewster. The first idea of this remarkable property occurred to him in the course of some experiments in which he was engaged on the polarisation of light, during the year 1814. But the only circumstance which at that time attracted his attention, was the circular arrangement of the images of a candle round a centre, and the multiplication of the sectors formed by the extremities of the plates of glass, between which the light had undergone several successive reflections. In repeating, at a subsequent period, some experiments of Mr Biot on the action of homogeneous fluids upon polarised light, and in extending them to other fluids which he had not tried, Dr Brewster happened, for greater convenience, to place them in a triangular trough, formed by two plates of glass, cemented together by two of their sides, so as to form an acute angle. The ends being closed up with pieces of plate glass cemented to the other plates, the trough was fixed horizontally, for the reception of the fluids. The eye being necessarily placed without the trough, and at one end, some of the cement which had been pressed through between the plates at the object end of the trough, appeared to be arranged in a remarkably regular and symmetrical manner. Pursuing the hint thus obtained, and investigating the subject optically, he discovered the leading principles of the kaleidoscope, in as far as the inclination of the reflectors, the position of the object, and that of the eye, were concerned. He then constructed an instrument in its simplest form, and showed it to some of the members of the Royal Society of Edinburgh, who were much struck with the beauty of its effects. Several very material improvements were subsequently made by the inventor in the construction and application of the instrument, for which he then took out a patent. But, in consequence of one of these instruments having found its way to London, its properties became generally known before any number of the patent kaleidoscopes could be prepared for sale. It very quickly became popular; and the sensation it excited in London throughout all ranks of people was astonishing. Kaleidoscopes were manufactured in immense numbers, and were sold as rapidly as they could be made. The instrument was in every body's hands, and people were every where seen, even at the corners of streets, looking through the kaleidoscope. It afforded delight to the poor as well as the rich: to the old as well as the young. Large cargoes of them were sent abroad, particularly to the East Indies. They very soon became known throughout Europe, and have been met with by travellers even in the most obscure and retired villages in Switzerland. Dr Brewster states, that no fewer than two hundred thousand kaleidoscopes were sold in London and Paris in the space of three months; "and yet," says he, "out of this immense number there is, perhaps, not one thousand constructed upon scientific principles, or capable of giving any thing like a correct idea of the power of the kaleidoscope; and of the millions who have witnessed its effects, there is perhaps not one hundred who have any idea of the principles upon which it is constructed, and of the mode in which those effects are produced." To convey a knowledge of these principles is the object of the present article.

Optical principles on which it acts.

It follows from the optical law of the equality of the angles of which the incident and reflected rays make with a line perpendicular to the reflecting surface at the point of incidence (see *Encyclopædia*, OPTICS, § 169, 172), that rays which diverge from any object and fall on a plane surface, will, after reflection, proceed in the same course as if they had immediately diverged from a point situated at the same distance behind the reflecting surface as the radiant point is before it. This point is called the *virtual focus* of those rays; and the eye receiving them will have the perception of a reversed image of the object in this situation. Thus the miror AA′ (Plate XCIII. fig. 1) will produce a reversed image of the object R, situated at the point S, in the line RpS, perpendicular to the surface of the mirror; and this image will appear in the same place what-

ever be the situation of the eye, as E, provided the reflected rays rE meet it.

Since the course of the reflected rays is the same as if they had immediately proceeded from a real object of S, where its image is seen, this image will, with relation to another mirror, have all the effect of a real object; and a second reflection of the rays by a new mirror at BB′, will produce, at the point T, equally distant from BB′ as S is, but on the other side of it, an image of the first image, visible to the eye at E by the twice reflected rays $RqvE$. As the first image was reversed with respect to the object, so the second image will be reversed with respect to the first, and therefore direct when compared with the object. The second image may, it is evident, by a new reflection from the first mirror, give rise to a third, which will now again, like the first image, be reversed; and so on, in succession, may a series of images alternately reversed and direct, be produced on each side by two mirrors only, in consequence of multiplied reflections, provided the mirrors are of sufficient extent to admit of them, and provided the eye be so placed as to receive the rays which are last reflected.

If the mirrors be parallel to each other (see fig. 2,) the images of the intervening objects, AA′BB′, will be ranged in succession in a continued line on each side. If they be somewhat inclined to each other (as in fig. 3,) the images will be disposed in the arch of a circle, having for its centre the point in which the directions of the mirrors unite. If the mirrors be of sufficient length, or sufficiently inclined, so as actually to meet; and if, moreover, the angle they form be an even aliquot part of a circle, the images of all the objects situated in the space between them, ABC, fig. 4, will together occupy a circular field, and will be disposed in the form of sectors all round the circle.

General method of tracing the course of the Rays.

This circular arrangement of the images, however legitimately it may have been deduced from the simplest law of optics, appears to be so extraordinary an illusion of the sense, as to call for somewhat further examination before we can feel perfectly assured that it is a necessary consequence of that law. Perhaps the most satisfactory method of prosecuting their examination is to investigate separately the mode in which each of the images results from the successive reflections by the two mirrors. A very simple and convenient rule may be laid down for enabling us to trace the whole course, however complex, of the rays which form these images; and this rule will be best understood by considering, as an example, its application to one of the remote images in the circular field. Thus, in the circular field, AHL, fig. 5, divided into equal sectors by the radii CF, CG, CH, &c. let S be one of the remoter images of the object R, formed by four reflections from the mirrors AC, BC; and let E be the place of the eye. Draw the line ES, intersecting the radii already mentioned in P, Q, T, V; make Cq equal to CQ, and join Pq; make Ct equal to CT, and join qt; make Cv equal to CV, and join tv, and vR. Then $RvtqPE$ will be the real course of the rays, by which the image of R is seen at S by the eye at E; for it is sufficiently apparent, without the necessity of a formal demonstration, that by this construction, the equality of the angles of incidence and reflection is every where preserved. The different positions of the line PS, that is PQ, QT, TV, and VS, are in fact the images of Pq, gt, tv, and vR respectively, which are so many portions of the real course of the reflected rays. It is evident that a similar construction will, in every other case, furnish us with the actual course of all the rays from which images result, through all their successive stages of reflection; and it has also the advantage of giving us the exact angles of incidence and reflection throughout the whole path.

We have hitherto, for the sake of perspicuity, supposed both the object and the eye, together with the path of the rays, to be in the same plane. But it is obvious that the same method of construction and of reasoning may be employed in tracing their course, if we suppose the mirrors to be prolonged in a direction perpendicular to the plane of the figure, and the eye raised above that plane. The space between the mirrors, instead of being the sector of a circle merely, is now the sector of a cylinder; which cylinder may be completed by supplying the other sectors which compose it, as is represented in fig. 8, where $ACac$ and $BCbc$ being the mirrors, the rest of the cylindrical space is occupied by complementary sectors. The course of the rays by which the eye at E will see the image S, for instance, of the object R, may readily be traced by drawing a straight line from E to S, which will pass through as many planes $BCbc$, &c. as the rays have suffered reflections. The portions of the line ES, intercepted between these planes, may, as in the former case, be regarded as the images (either reversed or direct, as the case may be) of some portion of the actual path of the rays between the mirrors; A will occupy the same position with regard to the complementary sector it traverses, as the real path does in the original sector bounded by the mirrors. By drawing, in this sector, lines similarly situated with respect to its sides, at the several portions, PQ, QT, TS of the line ES, are with respect to the sides of their respective sectors, we obtain the real course of the rays, $RtqpE$.

Creation of symmetrical appearance.

Symmetry appears to be the principal constituent of beauty in the forms given to the various works of art which have exercised the skill and ingenuity of man; and the richness of each individual ornament, as well as the pleasing effect of the whole assemblage, is generally in proportion as this principle has received a more perfect developement. Even nature, in the multitude of forms with which she has invested the different tribes of the animal creation, has, with but few exceptions, followed the law of symmetry, in as far as respects the perfect similarity of the two sides of the body. In almost all the higher classes, or those which are comprehended under the great division of vertebrated animals, and in many of the inferior tribes, as in insects, one half of the animal form is the reflected image of the other half. A still higher degree of beauty, derived from a more extended symmetry of form, has been displayed in the structure of objects in the vegetable kingdom. Flowers, in particular, derive a peculiar

Kaleidoscope.

beauty from their presenting to the eye a symmetrical combination of forms with reference to a common centre. This is also the general model followed in the structure of radiated animals, of which the star-fish and sea anemone are examples. In those works of art in which there is the greatest scope for the indulgence of fancy in the production of pleasing effects, the most perfect and successful kinds of ornament are those resulting from a symmetrical arrangement of parts, which is not confined to a single lateral repetition, but is extended in various directions in space, and is multiplied and alternated in different lines, and around different centres. It is the latter of these combinations, more especially, that is represented by the kaleidoscope, namely, the disposition of a certain number of pairs of images symmetrically disposed around one or more centres.

On examining the subject more minutely, we find that the first element of this symmetry consists in the union of any particular form, or of its direct image, with its reversed image, by which a new form is created, composed of two simple forms similar to each other, and similarly situated with respect to a given line. If a succession of these compound forms be now arranged around a centre, they will combine into a perfect whole, in which all the similar parts are brought into union, and which must thus afford pleasure, by enabling the mind readily to take in and comprehend every part at a single glance. The operation of the kaleidoscope is, in this way, to create regularity and symmetry out of every form that is presented to it, however irregular in itself that form may be. Thus, out of the few simple lines contained in fig. 9, the appearance presented in fig. 6 is created by the instrument. It is scarcely necessary to observe, that the original lines, which occupy the sector between the mirrors, are seen by direct vision, and that their appearance unites itself on each side with their images seen by reflection. We shall in future designate the whole of the appearance thus produced by the kaleidoscope, by the term *Spectrum*.

Appearances of polygons, stars, curves, &c.

If we examine the effect produced by each elementary portion of the compound figure of the spectrum, we shall find that any straight line reaching directly across the sector, as *fg* (fig. 9), is formed by the kaleidoscope into a regular polygon, having as many sides as the numbers into which the circular field is divided: if it be at right angles to either of the sides, the polygon will have only half the number of sides. A line, as *mn*, crossing the field between the mirrors in an oblique direction, is converted by the instrument into a polygon of the same number of sides as the former, but with salient and re-entering angles; that is, into the form of a star, with a number of rays equal to half the number of sectors. Another line crossing the field in an opposite direction, gives another star, having its rays intermediate to those of the former. Curved lines form by their union a multitude of beautiful and elegant figures, of which the variety is inexhaustible. Each group, taken separately, possesses its peculiar and intrinsic beauty; but the effect of the whole assemblage is considerably heightened by the combination, and by the regularity of the relations that each part bears to all the others.

Requisite conditions.

Having thus given an account of the general principles upon which the kaleidoscope is constructed, and of the mode in which it acts, we are now prepared to direct our attention to the conditions which are required for the perfect performance of its functions.

Economy of light.

If the mirrors of the kaleidoscope could reflect the whole of the light which falls upon them, the images would possess the same degree of brilliancy as the objects from which they are derived; and their number would be limited only by the more or less favourable position of the mirrors, and of the eye with relation to the objects. But as a very large portion of the incident light is, in most cases, destroyed by reflection, it follows that each successive image will be fainter than that which preceded it; and that in the progress of the reflections we must very soon arrive at a limit beyond which they become no longer visible. It is found, from experiment, that the quantity of light lost by reflection is in all cases greatest when the rays fall perpendicularly on the mirror, and least when they fall with the greatest obliquity. The difference is more considerable in the case of glass, than in that of metallic surfaces. Thus, in a common looking-glass, the images of objects seen by holding it directly opposite to them, are produced wholly by the surface of the quicksilver, those reflected by the glass being too faint to occasion any interference. If the glass be placed obliquely, so that the angles of incidence and reflection be large, a greater proportion of light will be reflected from the glass, and the images formed by it will be bright enough to be seen, and will mix themselves with the images from the quicksilver. At a certain angle, both sets of images will appear of equal brightness; and by still further increasing the obliquity, those produced by the quicksilver will gradually fade away, and vanish, leaving the images produced by the glass perfectly distinct, and nearly as brilliant as the objects themselves.

The following table, abridged from one given by Dr Brewster, and founded on the experiments of Bouguer, shows the number of rays reflected from plate glass at various angles of incidence, the number of incident rays being supposed to be 1000.

Complement of the angles of incidence.	Rays reflected out of 1000.	Complement of the angles of incidence.	Rays reflected out of 1000.
$2\frac{1}{2}°$	584	30	112
5	543	35	79
$7\frac{1}{2}$	474	40	57
10	412	50	34
$12\frac{1}{2}$	356	60	27
15	299	70	25
20	222	80	25
25	157	90	25

With the help of this table, and the method above explained of tracing the course of the rays, and on investigating the angles of incidence, the degree of illumination of any part of the spectrum might be

Kaleidoscope.

calculated, were it not for a new condition, termed *polarisation*, with which the rays of light are affected by reflection, and which may also contribute to the further loss of light, when the reflection is repeated at certain angles, and in certain positions of the plane in which it takes place: a circumstance which is not without its influence in the case of the kaleidoscope, especially in those constructed with glass mirrors.

As the effect which the kaleidoscope is intended to produce is to be the result of repeated reflections, it is an object of essential importance, in order that as little light may be lost as possible, that all these reflections should take place with the greatest obliquity. With this view, the mirrors should be of considerable length, and the eye should be raised above the field of view, and brought as near as possible to the planes of the mirrors; that is, as near as possible to the remote end of the line of their intersection. From this situation the remoter sectors will be seen by a greater quantity of light than from any other; and consequently the illumination of the spectrum will be more equal in every part. This position of the eye affords the further advantage of giving to the spectrum a circular appearance: for it is obvious, that if viewed from any other and more oblique situation, it would, from the laws of perspective, appear more or less elliptical. It is scarcely necessary to remark, that the eye cannot be mathematically in the line of junction of the mirrors, for no light would in that case reach it by reflection from them.

Proper Form of the Mirrors.

The essential parts of the kaleidoscope, then, are the two mirrors ACE, and BCE, (fig. 10), which should be from six to ten inches in length, and from one inch to an inch and a half in breadth at the object end C; while they are made narrower at the other end, E. They are kept apart at their upper edges, and united along their lower edges CE, so as to form an angle which must be an even aliquot part of a circle. The angles 36°, 30°, 25°$\frac{5}{7}$, 22°$\frac{1}{2}$, 20°, or 18°, which divide the circumference of the circle respectively into 10, 12, 14, 16, 18, and 20 equal parts, are the only angles which can conveniently be employed with glass mirrors. The objects to be viewed must occupy the space ABC, between the ends of the mirrors, and must be situated in the plane formed by these lines They are to be viewed from the opposite, or narrow end, *e*; the eye being placed near to the angular point, E, formed by the junction of the ends of the mirrors. It should, however, be a little above this point, in order that a sufficient quantity of light may enter through the pupil. By trial, the proper distance at which the maximum of illumination is obtained will easily be found.

Accuracy in their Junction.

It is of considerable importance that the junction of the mirrors be a perfectly straight line, free from roughness, and from particles of dust. Any irregularity in this line will interfere with the perfection of the image at that part most remote from the object. The projection of this line of junction of the mirrors on the field of view is a line CD, fig. 4, immediately opposite to the middle of the space between the mirrors. If tolerable pains have been taken to apply a straight and smooth edge of one mirror upon the surface of the other, and to preserve them clean, this line will scarcely be seen, more especially as the greater part of it is placed much nearer than the objects contemplated, and lies, therefore, within the distance to which the refractive powers of the eye are adapted; it is, therefore, seen only indistinctly.

Angle of their Inclination.

Any deviation in the angle formed by the mirrors from that which accurately divides the circle into an even number of sectors, is quickly perceived by the eye, from the consequent irregularity which takes place in the compound figure of the spectrum at the part most remote from the object. This is illustrated by fig. 7, where the last ray of the star is seen to be imperfect, from the want of correspondence in the images which meet in the remote sector. If the angle be too small, the image is redundant, from a reduplication of one portion; if too large, the image presents a deficiency. But, in consequence of the aperture of the pupil being of sufficient size to admit portions of the images from both mirrors, reflected from the parts immediately adjacent to the line of their junction, these two images will be, for a certain space, seen in the same direction, and will consequently overlap and interfere with each other. As soon as the angle of the mirrors is rendered correct, the double images coalesce into one, and perfect symmetry is restored to the spectrum. It is necessary to observe, that the angle must be an *even* aliquot part of a circle; that is, must divide it into an even number of equal parts. If the division were into an odd number of parts, as in fig. 7, the discordance of the adjacent images at the remote sectors would be the greatest possible. This will appear from considering that the images in the successive sectors on each side, being alternately reversed and direct, those in the sectors immediately adjacent to the radius most remote from the mirrors, would both be of the same kind; the one, therefore, could not be the reverse of the other, a relation which, as we have already seen, is the elementary condition of symmetry in each pair of images. The corresponding parts of each, indeed, instead of being adjacent, would then be the most remote from one another. This circumstance, namely, the necessity of the angle of the mirrors being the even aliquot part of a circle, although it be an essential condition of the instrument, is not mentioned in the specification of Dr Brewster's patent. It was first noticed by the author of this article, in the *Annals of Philosophy*.

Dimensions of the Mirrors.

If we investigate the proportion of light distributed over the field of view, by considering the degrees of obliquity with which the rays infringe upon the mirrors, and also the number of reflections which they sustain, we shall find that it diminishes nearly in the same proportion as we recede from the edge of the sector bounded by the mirrors, and is least in the remotest sector. The line of equal illumination in each individual sector, or the *isophotal* line, as Dr Brewster has termed it, is parallel to that radius of the sector which is nearest to the mirror on that side. It follows as a consequence, that the light will diminish in each sector in proportion as we recede from the angular point, or common centre of the field. This last circumstance limits us to the magnitude which it would be proper to allow to the field

Kaleidoscope.

of view, and therefore restricts us, in the breadth of the mirrors, when they are of a given length. In general, their breadth should not exceed one-sixth of their length, and the angle subtended by the circular field will then be about 19°. The proper proportion, however, varies according to the angle at which the mirrors are inclined. The larger this angle, the greater latitude may be allowed in extending the field of view; while, if the angle be small, the number of reflections for completing the remote parts of the spectrum will be great; the light will become too faint to allow the eye to distinguish the parts at the circumference; and the diameter of the field must be contracted by lessening the breadth of the mirrors.

What has now been said relates only to the proportional length and breadth of the mirrors. With regard to their absolute size, we must be guided in our choice by other circumstances of convenience. As the length of the instrument determines the distance of the eye from the field, it should be such as to admit of the distinct vision of every part of the spectrum. This may be effected, if requisite, by interposing a convex lens of the proper focal distance, between the eye and the narrow end of the mirrors.

Position of the Objects.

The last circumstance we shall notice as essential to the perfect operation of the instrument, is, that the objects must be situated as nearly as possible in the plane ABC, fig. 10, formed by the ends of the mirrors. All deviations from this position are productive of irregularity in the spectrum. If the eye, indeed, were a mere mathematical point, and were it possible for it to receive the rays while placed at the very point of the angle E, the distance of the object from the mirrors would, in strictness, produce no deviation from symmetry. Let the plane MN be taken at a little distance from the ends of the mirrors, and the planes of the mirrors produced till they meet it in the lines *ac* and *bc*. It is evident that the space comprehended between these lines, is the only situation in that plane from whence rays can proceed so as to fall upon the mirrors; no object, therefore, which is not within that space, can have its image formed by reflection from the mirrors. The lines *ac* and *bc* are the projections of AC and BC, as viewed from the point E. But if the eye be raised to *e*, it will be apparent that a space below the former, and bounded by the lines *de* and *fe*, which will now be the projections of AC and BC, will come into view. The objects situated in this space will have no corresponding images, and their introduction into the field of view will produce confusion in every part of the spectrum. The magnitude of this additional space, measured by the interval *cr*, which is unrepresented by the instrument, and which may be termed the *aberration*, is dependant upon and proportional to two separate causes, namely, the distance of the eye from the angular point, and the distance of the object from the mirrors. The deviation from regularity which it produces in the spectrum increases as the object approaches to the centre. An eye accustomed to observe and admire the symmetry of the combined images, will instantly perceive it to be violated, even when the distance of the object, Cc, is less than the twentieth part of an inch. When the object is very distant, the defect of symmetry is so enormous, that, although the object is seen by direct vision, and also in some of the sectors, it is entirely invisible in the rest. If the object, on the other hand, be placed within the reflectors, a symmetrical spectrum will, indeed, be formed; but the centre of this spectrum will not coincide with the centre of the circular field of view, and its effect in producing a symmetrical picture is thereby entirely destroyed. In order to ensure perfect mathematical symmetry, the objects should, strictly speaking, be limited to lines lying in the same plane, which plane must be exactly in contact with the ends of the mirrors.

Polycentral Kaleidoscopes.

We have hitherto considered the effects resulting from the combination of only two mirrors, in which case, the field of view is necessarily limited to a circle. But, on the very same principles, we may, by employing a greater number of mirrors, obtain an extension of this field in all directions, and produce groups of images around several centres, which shall be repeated in perpetual succession on every side. Kaleidoscopes of this description have, on that account, been called *Polycentral*, and, when properly constructed, their effects are exceedingly beautiful. With respect, also, to their utility, as applicable to the arts, they very far excel the simple kaleidoscope, inasmuch as the occasions requiring an ornamental design for a flat extended surface, are of much more ordinary occurrence than those in which we are limited to a circular space. The principles upon which polycentral kaleidoscopes should be constructed, and the conditions to which they are limited, were first pointed out by the author of this article, in the *Annals of Philosophy*, Vol. XI. p. 375, soon after the common instrument became known in London.

Only four species admitted of.

It is evident, that, by joining together a number of mirrors, so as to compose the sides of a prism, we might obtain a succession of images in every possible direction. But we must recollect, that for the production of symmetrical combinations of images, we are restricted in our choice of a base for the required prism to such angles only as will divide the circle into an *even* number of aliquot parts. This condition confines us to a very limited range. It excludes, in the first place, all angles above 90°; and, therefore, all polygons having more than four sides. Of four-sided polygons, the square and the rectangle, where all the angles are right-angles, are the only figures that can give symmetrical combinations. After these, there remain only triangles; and among all the possible varieties of triangles, we can take only such as are formed with angles of 90°, 60°, 45°, or 30°, which are the quotients of 360°, divided by 4, 6, 8, and 12; all the other even aliquot parts of the circle being excluded by the necessary condition that the sum of those angles must be equal to 180°. We are, therefore, limited to the three following species of triangles, represented in figures 15, 16, and 17:

The first having all its angles equal to - -	60°, 60°, and 60°.
The second its angles respectively equal to - -	90°, 45°, and 45°;
And the third its angle respectively equal to - -	90°, 60°, and 30°.

The sum of these angles, in each case, being 180°.

Kaleidoscope.

Let us now inquire into the effects resulting from each of these combinations.

Comparative effects of the

The comparative effects of these four species of polycentral kaleidoscopes are illustrated by figures 14, 15, 16, and 17, where A, in each case, represents the sections of the mirrors, or the base of each prism; B, the elements of each pattern; and C, the pattern itself, resulting from the series of reflected images.

Square Kaleidoscope,

It will be seen that the square polycentral kaleidoscope, fig. 14, produces a less pleasing effect than the others, because the attention being more particularly directed to the repetition of the same set of images in one direction only, the whole pattern appeors composed of an alternation of longitudinal stripes. The direction of the stripes is determined by the general direction of the lines, in the elementary pattern approaching more to one of the sides of the base, than to the other side. It is scarcely necessary to observe, that the spectrum produced by a rectangular is quite similar to that of a square kaleidoscope, only that it is more extended in one direction.

Triascope,

The first of the triangular polycentral kaleidoscopes (fig. 15), which has for the base of its prism an equilateral triangle, affords very regular combinations of images, disposed in three different directions, which cross each other at angles of 60° and 120°; thus presenting what may be called a triangular symmetry. The circumstance of each pair of images being combined in groups of three together in every part of the spectrum, has suggested the name of *Triascope* for this species of triangular polycentral kaleidoscope.

Tetrascope,

The second species of triangle (fig. 16), which may be made the base of the prism, is that composed of two contiguous sides, together with the connecting diagonal of a square; or, in other words, of a right-angled isosceles triangle. The result of this construction is to produce a division of the field of view into regular square compartments, having the base of the above mentioned triangle for their sides. The very perfect symmetry which results from this construction is the source of remarkably beautiful designs; the predominant character of which is an arrangement of forms grouped together by fours at a time, and symmetrically disposed in squares. Such an instrument may, on this account, be called a *Tetrascope*.

and Hexascope.

The last species of triangular polycentric kaleidoscope, or that which takes for its base the half of an equilateral triangle (fig. 17), resulting from its division by a perpendicular drawn from an angle to the opposite side, affords also appearances of very considerable beauty. Here the predominant form is the hexagon, from the circumstance that the smallest of the angles, which is that of 30°, producing the greatest number of repetitions of the same image around one centre, the symmetry is most conspicuous with reference to that centre, and the attention of the spectator is immediately directed to the hexagonal compartments into which the field is thereby divided. As the pairs of images in these leading objects (such as the stars in the figure, which, it will be observed, have each six rays) are six in number, we shall, following the analogy of the other names, denominate this variety of the instrument a *Hexascope*. These names, derived from the circumstance which gives the chief character of symmetry to the extended spectrum, will perhaps be considered as sufficiently appropriate. They will, at all events, recommend themselves by their brevity, when we consider the very compound epithets which would otherwise be required in order to designate correctly the equiangular, triangular, polycentral kaleidoscope; the rectangular, isosceles, triangular, polycentral kaleidoscope; and the semi, equilateral, triangular, polycentral kaleidoscope.

As a plane surface of indefinite extent admits of subdivision, by regular polygons of the same kind, only in three ways, namely, by triangles, by squares, and by hexagons, so each of these modes of division is the result of a separate arrangement of three plane mirrors, namely, that of the triascope, the tetrascope, and the hexascope. Of these, the two last appear to be those more especially calculated to afford assistance to artists in the invention of ornamental patterns.

It is evident, that the principal advantage which the polycentral kaleidoscopes have over the simple ones, is the greater extension they give to the field of view. This field might, in theory, appear to be infinite; but in practice it soon becomes limited, from the great loss of light attendant on repeated reflections. The effects of polarisation, in further diminishing the light, is also greater in them than in the simple kaleidoscope. On both these accounts, metallic are preferable to glass mirrors for their construction. The number of reflections required, in order to obtain any extent of spectrum, being greater than in the ordinary kinds of simple kaleidoscopes, the instrument must be of greater length comparatively with the breadth of the mirrors, as in this way the course of the rays will be more oblique with respect to the mirrors, and a larger portion of light will reach the eye. A greater obliquity is also obtained, with the same proportion between the length and breadth of the mirrors, by making them taper at the end next the eye. The instrument will then, see fig. 18, have the form of a truncated pyramid, instead of a prism; ABC being the triangular base, to which the objects are to be applied, and *abc* the narrower end at which the eye is applied. It is true, that, in mathematical strictness, this construction is incorrect; for the mirrors, in that case, having necessarily a degree of inclination to the base, the spectrum will be composed of portions, not of a plane, but of a spherical surface, which does not admit of the same divisions; but the field really visible to the eye is too limited to render this inaccuracy of any consequence.

Construction of the Simple Kaleidoscope.

After the detailed explanation which has been given, of the principles on which kaleidoscopes act, it will not be necessary to enter into any minute account of the methods of constructing them. A few practical directions may, however, be useful for the guidance of such as wish to provide themselves with this source of innocent amusement. In order to construct the simple kaleidoscope, two slips of plate-glass, about six or eight inches long, and about an

Kaleidoscope.

inch, or an inch and a half in breadth, must be procured. The best form for these plates is that represented in fig. 10, where one end of them is only half the breadth of the other. The newest plate glass should be employed, as that which is old has frequently scratches and imperfections on its surface, which occasion a great loss of light. They should have been skilfully cut with a diamond, so that at least one of the edges may be perfectly smooth, and free from chips. If this be not the case, one of the edges must be made quite straight, and freed from all imperfections, by grinding it with very fine emery upon a flat surface, such as another piece of plate-glass. The posterior surfaces of each of the plates are now to be covered with a black varnish, or with black sealing wax, so as to remove its reflective power. When this has been done, and the varnish is dry, take the plate of which the edge has been rendered perfect, and apply this edge against the surface of the other plate, as near as convenient to the edge of this latter plate, and keep the edges so applied in contact, by means of a strip of black silk or cloth glued along the back of the plates, so as to serve the purpose of a hinge, allowing of their opening and closing to a certain extent, like the leaves of a book. They are now to be adjusted to the proper angle, which may be done with the greatest accuracy, by directing the mirrors, placed as in fig. 10, to any line, or the straight edge of any object in contact with the broad ends, and very obliquely situated with respect to the edge of either of the mirrors; then looking from the other end, open or shut the plates till the figure of a star appears, having 6, 7, 8, or any other number of rays which may be thought desirable, and observing that the images of the rays in the spectrum most remote from the object perfectly coalesce. The mirrors must now be fixed in their position by small arches of wood or brass, extending across the open ends of the plates AB in two or three places. These may at first be attached temporarily by means of sealing-wax; but they should afterwards be fastened more securely by other pieces glued to the plates in several places along the edges Ae, Be. The clearness of the effect of the instrument is much promoted by excluding all light, except what comes from the field of view; and this is best accomplished, by laying a strip of black velvet, previous to the fixing of the pieces just described, all along the upper side of the instrument, so as to line the whole of the space between the upper edges of the mirrors. All reflection of light from that quarter is thus effectually precluded.

The plates thus prepared are to be placed in a tube, as represented in fig. 11, so that the broad ends of the mirrors shall barely project beyond the end of the tube; while the narrow end is placed so that the angle formed by the junction of the mirrors, shall be a little below the middle of that end of the tube. The plates must then be kept in this position by pieces of cork or wood, wedged in between them and the tube; taking care, however, that they press but lightly on the mirrors, for a very slight force is capable of bending and altering the figure, even of very thick plates of glass. A cover, with a circular aperture in the centre, is then to be fitted to the end *abc*, which should, in general, be furnished with a convex lens, whose focal length is an inch or two greater than the length of the mirrors, in order to allow the eye to see every part of the spectrum with perfect distinctness. Persons who are short-sighted will of course not require this lens; but it will still be expedient to close the end *abc* of the mirrors, with a piece of plane glass, as a security against the introduction of dust.

Of Polycentral Kaleidoscopes.

In constructing polycentral kaleidoscopes, where three mirrors are employed, the third mirror occupies the place of the black velvet and connecting pieces already described. Great care should be taken to have three very perfect edges for the junctions of the plates with each other; and considerable attention should be paid to their being fixed at the exact angles required by the construction; and when once placed correctly, they are to be retained in their relative position by effectual securities. Similar remarks apply to the construction of square and rectangular polycentral kaleidoscopes.

Revolving Object Case.

The instrument, when so far completed, is now ready to be applied to the objects which are to form the spectrum. A case for holding these objects, and for communicating to them a revolving motion, is fitted to the object end of the tube: the best construction for such a case is the following. Upon the end of the tube *abcd*, fig. 12, (corresponding to the end of the mirrors ABC, fig. 11), is placed a ring of brass, *mn*, which moves easily upon the tube, and is kept in its place by a shoulder of brass on each side of it. A brass cell, MN, is then made to slip tightly upon the moveable ring *mn*, so that when the cell is turned round by means of the milled end at MN, the ring *mn* may move freely upon the tube. The objects are to be placed in a small box, consisting of two glasses, one transparent, and the other ground, kept at the distance of one-eighth or one-tenth of an inch by a brass rim. This brass rim should consist of two pieces which screw into one another, so that the box can be opened by unscrewing it, and the objects changed at pleasure. This object box is placed at the bottom of the cell MN, as shown at OP; and the depth of the cell is such as to allow the side O to touch the end of the mirrors, when the cell is slipped upon the ring *mn*. The instrument when used, is to be held in one hand, with the angular point E downwards, and the cell is turned round with the other, so as to present the objects in succession before the aperture ACB, fig. 11.

Selection of proper Objects.

The objects best fitted for producing pleasing effects, are small fragments of coloured glass, of sufficient size to occupy a certain portion of the interval between the mirrors, but not so large as to engross the greater part, or to interfere with each others motions, as they are made to fall in succession into the field of view, by the revolution of the case which holds them. Wires of glass, both spun and twisted, and of different colours, and shades of colours, and of various shapes, both curvilineal and angular, may be intermixed with the larger masses of coloured glass, together with one or two beads, bugles, fine needles, bent metallic wires, small pieces of lace, and fragments of fine sea-weed. Looped curves like the figure 8, double curves like the letter S, or the

Kaleidoscope.

figure circles, ovals, spirals, triangles, or lines bent into angles, like the letter W or Z, have generally a good effect, either alone, or in combination with other objects. Care should, however, be taken not to crowd the case with too many objects at a time, as an excess in this respect produces a degree of complexity totally inconsistent with beauty. In order to obtain a greater variety in the styles of patterns produced, a number of different cases, with objects may be provided, so as to fit on occasionally, and be changed at pleasure.

Telescopic or Compound Kaleidoscope.

By Dr Brewster's very ingenious contrivance of substituting for the case of objects above described, and which is applied in contact with the ends of the mirrors, a convex lens placed at a certain distance from them, the images of distant objects may be brought to occupy the exact place adapted for their reflection by the kaleidoscope, and may thus afford a still greater variety of symmetric conbinations. This operation of the lens is illustrated by fig. 18, where the lens L forms an image of the object R at F, the space between the ends of mirrors, which image is multiplied by the reflecting powers of the instrument, and forms a symmetric spectrum, precisely in the same way as if a real object of that size had occupied its place. The lens may be fitted to the end of a separate tube, external to that of the instrument, and capable of being drawn out upon it to the proper distance, which is known by observing when the spectrum appears perfectly symmetrical. The instrument in this form has been called the *Telescopic* or *Compound Kaleidoscope;* and is applicable to distant objects of every description, and equally so to those in motion, as to those at rest. All their movements are represented with singular effect in the spectrum. A blazing fire viewed by it, gives the appearance of beautiful fireworks, at one time rushing with great rapidity towards the centre, and at another issuing from it towards the circumference, or darting in splendid starriform corruscations over the field of vision. These varieties in the spectrum are occasioned both by turning the instrument round its axis, and by moving it forwards in any direction.

The compound kaleidoscope has thus a much more extended range than the simple kind; and it has this further advantage, that it admits of the symmetry of the spectrum being rendered perfectly correct, since the images may be brought exactly to the ends of the mirrors; a condition which can never be completely obtained, when the objects are confined in a glass case, as they must then always be separated from the mirrors by at least the thickness of the glass.

The focal length of the lens should always be much less than the length of the outer tube, and should in general be such as to be capable of forming an image at the end of the mirrors, when the object is four or five inches from the lens. Its diameter should be such as that, when it is at its greatest distance from the mirrors, it shall still occupy the whole of the field of view which is seen by direct vision; or, in other words, that the eye shall not see any part of its edge.

Its application to the Magic Lanthorn, &c.

The exhibition of the effects of the kaleidoscope to a number of spectators at the same time, by throwing the images on a wall, after the manner of the magic lanthorn, or solar microscope, might be easily accomplished, if sufficient light could be procured for the illumination of the objects. The form of an instrument for this purpose, is represented in fig. 20, where L is the lamp, the light from which being augmented by the reflector M, and concentrated by the very convex lens N, upon the transparent objects at the end of the kaleidoscope K, is formed into an image on the opposite wall by refraction through the lens P, the focal distance of which is somewhat shorter than the length of the tube. The brilliant light produced during combustion, carried on by means of a stream of oxygen gas, is peculiarly fitted for the exhibition of these effects, as was very successfully shown by Mr William Allan, in his lectures at Guy's Hospital, London.

By a contrivance on a similar principle, the patterns formed by the kaleidoscope may be copied, if thought necessary, by receiving them in a camera obscura. The readiest mode of tracing them, however, is by the use of a camera lucida, applied to the instrument at the end next the eye. The kaleidoscope might also be be applied to the microscope, if it were worth while to multiply these applications, for which, however, considering the infinite variety of designs which the simpler instruments afford, there appears not to be the least necessity.

Solid Kaleidoscopes.

Instead of employing the exterior surfaces of glass as the reflectors, we may employ the interior surfaces of a prism of solid glass for that same purpose; and we may obtain in this way, as was shown by Dr Brewster, a total, instead of a partial reflection of light. This solid form of the instrument is peculiarly fitted for polycentral kaleidoscopes; but it is liable to the objection of its being extremely difficult to procure a piece of glass of sufficient size entirely free from veins, and also to obtain the perfect junction of the two reflecting planes.

Polyangular, Annular, and Rectilinear Kaleidoscopes.

Simple kaleidoscopes have been variously constructed with reference to the angles of inclination of the mirrors. In some instruments, called by Dr Brewster *Polyangular Kaleidoscopes,* this angle may be varied at pleasure, by allowing the mirrors to move on their connecting edges as on a hinge, so as to open or close at pleasure by means of a screw. Others admit of the mirrors entirely separating, so as gradually to become parallel to each other, and thus give rectilineal or annular patterns, as is seen in figures 2 and 3. But there is no occasion to dwell more particularly on these subjects, as the circumstances of their construction and effects must be sufficiently obvious from what has been already said; and there is probably more ingenuity than utility in devising these variations. We shall therefore conclude, by merely noticing a convenient mode of uniting several of these instruments, which was suggested by the author of this article, with a view to compare the effects of the simple and polycentric kaleidoscopes, applied to the very same set of objects. Fig. 20 shows a section of that instrument, in which *mn* are the mirrors of a simple kaleidoscope in the middle of the tube *t*, and which might be set to any angle; the mirrors *def* on one side forming a tetrascope, and *pqr* on the other, a hexascope. The whole was enclosed in the tube *t*, at the eye end of which were

three separate apertures, in order to allow the observer to look through each in succession. The other end was fitted with a case of moveable objects, as in fig. 12; and was also provided with an additional tube for the reception of a lens instead of the case, and capable of being drawn out, so as to convert the whole into a telescopic instrument. The effect of the whole combination was very striking.

See Dr Brewster's *Treatise on the Kaleidoscope*, Edin. 1819. Harris's *Treatise on Optics*. Wood's *Optics*. Dr Roget *on the Kaleidoscope*, in the *Annals of Philosophy*, Vol. XI. p. 375; and the *Compte rendu des Travaux de l'Académie de Dijon, pour* 1818, p. 108-117. (w.)

KANT (Immanuel), a very eminent metaphysician, and the author of that theory which has been distinguished by the name of the *Critical*, or *Transcendental Philosophy*, was born at Koningsberg, in Prussia, on the 22d of April 1724. Of his paternal ancestors little is known with certainty; but tradition represents them, as having sprung from an emigrant Scotsman, of the name of Cant; and the philosopher himself, who frequently alluded to this traditionary extraction, is said to have been the first of his family who changed the initial letter of his name to K, with a view to adapt it to the German pronunciation.

The father of Kant, who exercised the humble profession of a saddler, or harness-maker, in the suburbs of Koningsberg, was distinguished rather for his integrity and respectability, than for his wealth. His mother appears to have been a woman of considerable talents, and of a more decided character. She was exceedingly pious, and much attached to the strict religious tenets and discipline of Dr Schultz; a divine who, at that period, enjoyed an high reputation for learning, eloquence, and piety. * Kant uniformly spoke of both his parents, but especially of his mother, with feelings of the warmest affection. †

Although far from being in affluent circumstances, his parents resolved to bestow upon their son, Immanuel, every advantage that could result from a liberal education. Accordingly, after having been taught to read and write at the charity school of the suburbs, he was sent, in the year 1732, to the *Collegium Fridericianum*, at the suggestion, it is believed, of Dr Schultz; who, even at that early period, had the penetration to discover the talents of the boy. At this school, he contracted an intimate friendship with Ruhnkenius, afterwards so celebrated for his philological attainments, which was maintained by occasional correspondence during the remainder of their lives, and which, in their early years, may naturally be supposed to have had a salutary influence on the studies of both. They were both indefatigable students; and they not only mutually assisted each other in their school exercises, but read together, during their leisure hours, whatever books their inclination led them to peruse, or their circumstances permitted them to purchase. It is rather a remarkable circumstance, however, that, at this early period, Kant devoted his attention principally to philological studies; while his friend, Ruhnkenius, seemed to be attracted, by an apparently natural tendency of disposition, to the cultivation of philosophy. In their maturer years, as is well known, these early predilections were precisely reversed. ‡

Having completed his preliminary education, he repaired, in the year 1740, to the university of his native town, where he applied himself, with great ardour, to the study of the mathematical, philosophical, and theological sciences. Among the professors of Koningsberg, several of whom were men of considerable talents and attainments, he appears to have attached himself particularly to Professor Martin Knutzen, well known, at that period, as the author of several useful works, to whose instructions in mathematics and philosophy Kant acknowledged himself to have been greatly indebted. § To the great diligence and success with which he prosecuted his studies, at this period, his early writings bear ample testimony. The youth who, at the age of twenty-two, could boldly and successfully impugn the doctrines of Leibnitz and Wolf, and skilfully wield the weapons of dialectics against the authority of the most eminent metaphysicians of his day, must have bestowed no common pains in the acquisition of scientific knowledge, and in cultivating the powers of his understanding. From the earliest period of his career, too, he was left almost entirely to the resources of his own talents and prudence, and compelled, at every step, to struggle against the depressing influence of poverty. When scarcely arrived at manhood, he had the misfortune to lose both his parents, who had not the satisfaction of living to witness the fruits of their son's talents and industry. They, indeed, had never been able to afford him much pecuniary assistance; but he was fortunate in meeting with some relations of his family, who were in more affluent circumstances, and by whose liberality, combined with his own exertions and economy, he was enabled to continue the prosecution of his studies.

After a residence of about three years at the university, he acted in the capacity of a private tutor in several families, and lived about nine years with the Count de Hüllesen at Arnsdorf. During this period, he embraced the opportunities which his retirement afforded him, of collecting a vast store of general

* He was Professor of Theology at the University of Koningsberg, and the author of several works which were much esteemed in their day: among others, of a work on the *Elements of Metaphysical Science*.

† Kant had several sisters, and an only brother, several years younger than himself, who took orders, and had a living in Courland, where he continued to reside until his death.

‡ Throughout every period of his life, however, Kant retained a great fondness for classical literature. He was particularly partial to the study of the Roman writers; and, even in his old age, he delighted to have an opportunity of reciting and applying passages from the works of his favourite authors.

§ Knutzen died in the year 1756, as extraordinary Professor of Philosophy at Koningsberg.

Kant.

knowledge in almost every department of science and literature, and of sketching the outlines of several of those philosophical treatises, which were soon afterwards published in rapid succession.

It is rather unfortunate that no record seems to have been preserved of the course of his studies during this most interesting period of his life; nor has he himself, so far as we know, left any memorials which might enable us to trace the gradual progress of his mind in the acquisition of knowledge. It is certain, however, that he both read and thought much. According to his own confession, he was not particularly well qualified to discharge the duties of a tutor; being always too deeply engaged in acquiring and digesting knowledge in his own mind, to be capable of communicating the rudiments of it to others. His mind seems to have originally entertained a strong bias towards mathematical and physical researches, and he exhibited some specimens of knowledge, acuteness, and originality of investigation in the latter branch of science, from which much eminence might have resulted, had his views been exclusively confined to that department.

It was probably during the period of his retirement at Arnsdorf, that he was led to engage in a laborious investigation of the various metaphysical theories of ancient and modern times. With this view, he made himself master of the living languages, especially the French and English, the latter of which he acquired without the aid of a master, in order to enable him to examine into the merits of the British philosophers, particularly Locke, Berkeley, and Hume. To the sceptical conclusions of the last mentioned writer, according to Kant's own confession, the world is indebted for the *Critical Theory*.

Having attained his thirtieth year, and already distinguished himself as the author of several tracts, exhibiting great originality of thought, Kant resolved to devote himself to the profession of a public teacher. With this view, he returned to the university of Koningsberg, and took his degree of M. A., according to the usual forms, in the year 1755. It was upon this occasion that he produced, in the form of an inaugural dissertation, his tract entitled, *Principiorum primorum Cognitionis metaphysicae nova dilucidatio;* the first of his works, it is believed, which contained any hints respecting his peculiar views of metaphysical science. In the same year, he published his celebrated treatise on the *Universal Natural History and Theory of the Heavens; or an Essay on the Constitution and Mechanical Structure of the whole Globe, according to the Newtonian System.* In this treatise, by following out the principles of Newton, he was led to anticipate, in theory, some of the subsequent discoveries of the great practical astronomer, Herschel.

Soon after he had taken his degree, he began to avail himself of the privilege attached to the character of a *Doctor docens*, by delivering lectures publicly on Logic, Metaphysics, Mathematics, and Natural Philosophy; to which, at a subsequent period, he added the Law of Nature, Moral Philosophy, Natural Theology, and Physical Geography. He had not long commenced the discharge of his duties as a public teacher, when the concourse of students, whom the reputation of his profound and extensive learning attracted, was so great, that his *auditorium*, or lecture-room, although large and commodious, could scarcely contain the numbers who eagerly flocked to hear him. His affable manners and social talents, at the same time, rendered him a most acceptable guest at the tables of the most respectable inhabitants of Koningsberg, with several of whom he lived on habits of intimate friendship.

Kant.

But notwithstanding his acknowledged talents as a philosopher, and his popularity as a lecturer on scientific subjects, it was long before Kant obtained any preferment. With a mind constantly and intensely engaged in the pursuit of knowledge, he appears to have possessed no ambition beyond that of being useful in the sphere he had chosen for the exercise of his abilities; and he had too much simplicity of character to resort to any of those arts, by which other men, more emulous of distinction, frequently endeavour to advance their worldly interests. Upon the death of Knutzen, in the month of April 1756, he solicited the vacant extraordinary professorship of philosophy, but without success. The ordinary professor of Logic and Metaphysics, having died in 1758, Dr Schultz, who, as we have already observed, discovered at an early period the talents of Kant, and continued to patronize him so long as he lived,—exerted all his influence to obtain that situation for his *protegé*. But Kant was again disappointed. Not discouraged, however, by the repeated failure of his attempts to attain independence, he continued to deliver his lectures, and to meditate his writings. In the month of February 1766, he accepted the unsolicited situation of second keeper of the royal library, to which a small salary was attached; and at the same time he undertook the management of a private cabinet of curiosities. But these offices he resigned in 1772, on account of the interruptions to which he was exposed, in showing the books and rarities to strangers.

In the year 1770, Kant at length attained the highest object of his ambition, on his advancement to the ordinary Professorship of Logic and Metaphysics in the University of Koningsberg; a situation, which, while it placed him far above the fear of want, afforded him, at the same time, the best opportunity of employing his talents in a manner satisfactory to himself, and advantageous to his country. Upon this occasion, he produced his celebrated inaugural dissertation, *De Mundi Sensibilis atque Intelligibilis Forma et Principiis;* in which he propounded some of the fundamental principles of that metaphysical theory, to which he was afterwards indebted for his great reputation.

From this period, the life of Kant affords no very remarkable incidents for the pen of the biographer. His time appears to have been chiefly occupied in the faithful and zealous discharge of the duties of his office; in the composition of those philosophical works, by which he hoped to accomplish an important and beneficial reform in metaphysical science; and in cultivating the society of a select number of friends. At this time, too, he maintained a philosophical correspondence with several of the first literary characters of the age, and particularly with the

Kant. celebrated Lambert, then President of the Royal Academy of Sciences at Berlin, whose views of philosophy were, in some respects, coincident with his own. His letters to Lambert, indeed, are peculiarly interesting, as they contain frequent allusions to the gradual developement of his metaphysical ideas.

In the year 1780, he became a member of the *Senatus Academicus*; and, in 1787, he was admitted a member of the Royal Academy of Sciences at Berlin. Never, perhaps, did there exist a mind so ardently and so entirely devoted to the cultivation of science, and so utterly divested of all interested motives in the pursuit of knowledge. Having once attained independence, his ambition, as to worldly objects, seems to have aspired no higher. Although he received, at different times, various invitations, with most advantageous proposals, to induce him to transfer his talents and his reputation to other universities, he could never be prevailed upon to leave his native town; being perfectly satisfied with the advantages he already enjoyed, and with the sphere of usefulness which had been assigned him. For many years previous to his death, he was the senior professor of Koningsberg; and he enjoyed that high degree of respect and veneration, which was due alike to his advanced age, his eminent talents, and conspicuous virtues. He died, by a gradual decay of nature, on the 12th of February 1804, in the eightieth year of his age. His funeral was attended by the most respectable inhabitants of Koningsberg, and by a numerous train of his friends and disciples; and, to express the public regret for the loss of so distinguished a character, the whole city put on mourning. On his coffin there was placed a sepulchral urn, with the inscription: *Cineres mortalis immortalis Kantii.* A beautiful commemorative medal was also executed upon this occasion, by M. Abramson of Berlin. On one side is a striking likeness of the philosopher, with the inscription—*Immanuel Kant, nat.* 1724. On the reverse, the artist has attempted to express the services of Kant in assigning limits to the province of speculative philosophy, by representing a Minerva seated, and holding an owl in her right hand, which she prevents from flying, with the inscription—*Altius volantem arcuit.*

In his person, Kant was rather below the middle stature, of a slender and delicate form, and with a very narrow and flat chest. His bodily frame, indeed, did not seem to promise longevity; nor would he, in all probability, have attained so great an age, had not his constitution been preserved by his regular and temperate mode of living. In his external appearance, strangers found nothing prepossessing, or indicative of any uncommon talents; on the contrary, his features are represented by a gentleman who visited him at Koningsberg, as "a reproach to physiognomy." Others, however, describe his countenance as full of dignity, and expressive of benevolence. His natural disposition was cheerful and social; and his manners polite and affable. He exhibited none of that awkwardness, or reserve, which is frequently generated, or increased by habits of recluse meditation, and which is often thought to be characteristic of the scholar and man of science. He loved company, and was both inquisitive himself, and fond of communicating his own knowledge and opinions upon all subjects. There was nothing, however trifling it might appear, at first sight, which did not suggest to his mind some interesting reflections; and he could talk as fluently with a lady on the *minutiæ* of female dress, the mysteries of the kitchen, or the common occurrences of the day, as he could with a philosopher on the most abstruse points of science. He was very regular in his habits. He rose early; and his mornings were generally devoted to study and professional duties; his evenings to society. As he never entered into the married state, he was not encumbered with the cares of a family. He used to say, that when he would have married, he had not fortune sufficient to maintain a wife; and when he pessessed the requisite fortune, he had no inclination to marry. It has been remarked, that he was fond of society; and during the earlier part of his life, when otherwise disengaged, he used to dine at the ordinary of the principal tavern; by which means he had an opportunity of acquiring an extensive knowledge of human character, and, at the same time, of gratifying his inquisitive disposition, by eliciting from travellers of different countries many curious and valuable observations on the manners, habits, and literature of various nations. He possessed an intimate knowledge of geography, and even of minute topography, probably in a great measure derived from this last mentioned source, as well as from his private reading of books of travels, to which he was always extremely partial; and he frequently entered into local details with a degree of correctness, which could not fail to astonish those who learnt that he had never moved fifty miles from his native town. At a later period of his life, when more easy in his circumstances, he generally invited a few of his friends to dinner, with whom he relaxed from his graver studies, frequently enlivening his discourse with sallies of wit and humour, of which he possessed no small share, and occasional irony and satire, of that good-natured species which inflicts no wound on the object against whom it is directed.

Kant's intellectual faculties were of a high order. He had a wonderful power of reflection, which enabled him to unfold the most abstruse principles, and to pursue, in his own mind, a long train of conclusions. He possessed great quickness of observation, and clearness of conception; insomuch that, in conversation, he could describe any object which he had seen, or of which he had read, with admirable precision and accuracy. His memory was exceedingly retentive. He kept no library, but made a contract with a bookseller to send him all new publications, which he perused, and afterwards returned; and the knowledge thus acquired he had always at his command. The most remarkable feature in the moral character of Kant, was an utter abhorrence of every species of falsehood, however innocent, and a love of perfect honesty and sincerity, in word and action, flowing no less from his natural disposition, than from those high principles which he had early imbibed, of the value of truth, and the dignity of man. In this respect he was ever consistent with

 himself; and the whole tenor of his long life may be regarded as a practical commentary on his writings, and an exemplification of his moral maxims.

The peculiar doctrines of the critical, or transcendental philosophy, were not the offspring of impressions accidentally received, and hastily adopted; but the fruit of long, patient, and systematic investigation. Kant, indeed, was well advanced in years, before he attempted that reform in metaphysical science which he seems to have long meditated. In several of his earlier productions, and in his Letters to Lambert, he evidently appears to have been dissatisfied with the prevailing theories; and his inaugural dissertations, as already mentioned, exhibited some of those peculiar views, which were afterwards more fully developed in his great work, the *Critik der reinen Vernunft.* This work was published in 1781. For several years, it appears to have attracted little or no attention; and the publisher, it is said, was on the point of destroying the sheets, as waste paper, when a sudden demand rapidly carried off several impressions. From that period, the *Transcendental Theory* began to excite an extraordinary sensation, and to be regarded as a new and wonderful discovery in metaphysical science; the philosophers of Germany were divided into professed partizans and determined antagonists of the doctrines of Kant; and a multitude of publications issued yearly from the press, for the purpose of confirming or refuting the new principles.

It was not long, however, before the *Critical Philosophy* bore down all opposition, and obtained a complete ascendancy over the theories inculcated by its adversaries. It was publicly taught in the schools, to the almost total exclusion of the doctrines of Aristotle, Descartes, Locke, Leibnitz, and Wolf; it gave a fresh impulse to the spirit of metaphysical inquiry; and men of the first note in the scientific world felt a conscious pride in being able to comprehend, to explain, to illustrate, to apply, or to extend its principles. It not only effected an entire revolution in German Metaphysics, but exerted a powerful influence on works of taste, and the lighter literature of the country. It is impossible, indeed, to comprehend, or to relish, many passages in the works of the more recent poets, novelists, and fugitive writers of Germany, without some previous acquaintance with the doctrines of Kant.

Owing to what has been already said upon the subject in another part of this work (*Dissertation First*, Part Second, Section Seventh), we shall avoid entering into any discussion respecting the merits of the *Critical Philosophy* in the present article; but we shall present our readers with a very concise abstract of its objects and results.

Mr Hume proved very satisfactorily, that our ideas of *cause and effect* are not derived from experience; but he rashly concluded, as Kant observes, "that they are the spurious offspring of the imagination impregnated by custom." Kant discovered, that Hume had been led to this hasty inference, in consequence of having taken too limited a view of the great problem, which he had thus partially attempted to solve. He perceived that the idea of *cause and effect* is by no means the only one which the mind makes use of with the consciousness of its necessity, yet without being derived from experience; but that the science of metaphysics is altogether founded on ideas of a similar nature. He endeavoured, therefore, to ascertain the precise number of these abstract or transcendental ideas; and having succeeded in this to his own satisfaction, he found himself in possession of the whole of those connecting acts of the mind, which constitute the very elements of the understanding itself, which are indispensable to its exercise, and without which the whole of our experience would exhibit nothing but a number of insulated facts, without order or consistency.

The three original faculties, through the medium of which we acquire knowledge, are *Sense, Understanding*, and *Reason*. *Sense* is a passive, or receptive faculty. In the objects presented to our senses, we distinguish *matter* and *form*. The forms or conditions of sense are *space* and *time*. The former of the external; the latter of the internal sense. All our knowledge is limited by space and time; for we can perceive nothing that does not exist under these conditions.

Understanding is an active, or spontaneous faculty, and consists in the power of forming conceptions. In every conception of the understanding, also, we distinguish the *matter* and the *form*. The matter is the sensible intuition; the form is the unity, or connection, established by means of the synthetic powers of the understanding, or the categories. Kant was at great pains in endeavouring to ascertain the number of these synthetic powers, or categories; and he found them to be all comprehended under the four classes of *Quantity, Quality, Relation*, and *Modality*. The categories themselves are twelve in number. Under the first head are comprised *unity, multitude, totality;* under the second, *reality, negation, limitation;* under the third, *substance* and *accident, cause* and *effect, action* and *re-action;* under the fourth, *possibility, existence, necessity*.

This synthetic power of the understanding is called, in the critical philosophy, its *original* use. The *logical* use, both of understanding and reason, is to be found in the faculty of *Judgment*. Logic, however, has only to do with the form of our conceptions, and not with their matter; which last inquiry belongs to transcendental philosophy, or Metaphysics.

Reason is the third or highest degree of mental spontaneity, and consists in the power of forming ideas. As it is the province of the understanding to form the intuitions of sense into conceptions, so it is the business of reason to form conceptions into ideas. The ideas of reason are absolute and unconditional, and totally independent of space or time; consequently, we can neither obtain nor extend our knowledge by means of reason alone. For these ideas are nothing more than certain representations of the unconditional,—of the highest unity and totality,—which spring from the essential constitution of our reason, which serve to render the field of experience a comprehensible whole; and which, therefore, are merely conditions of the exer-

cise of our reason, and not real external objects, of which it is possible to acquire any knowledge by intuition.

The results of the critical theory may be stated, we conceive, in a very few words. The first principles, or conditions, of all our speculative knowledge, are mere *subjective* forms, *i. e.* forms derived from the constitution of the thinking being: First, the forms of sense, or pure intuitions (space and time); and, secondly, the forms or notions of the understanding (the categories). These intellectual forms or notions, however, only acquire reality by their application to our perceptions, with reference to possible experience; and, therefore, we can have no speculative knowledge of things beyond the sphere of experience.

Besides the critical investigation of pure reason, in its speculative exercise, Kant instituted a similar inquiry into the nature and laws of our *practical reason*, and of the faculty of *Judgment*; and, in the spirit of his own theory, he published the *Metaphysical Elements of Natural Philosophy*, of *Law*, and of *Ethics*. His *Logic*, *Physical Geography*, and some other works, were published, by his friends, from his papers, and the marginal notes to his text-books. Towards the latter end of his life, he meditated a work, which was intended to be the key-stone of his whole system, and which was to have been entitled, *The Transition from Metaphysics to Physics*; in which he proposed to demonstrate the general application of the principles of the transcendental theory. The decline of his faculties, however, prevented the execution of this projected work.

We shall close this article with a list of Kant's publications.

Gedanken von der wahren Schätzung der lebendigen Kräfte, &c. (Thoughts on the true estimation of the animal powers, with strictures on the proofs advanced by Leibnitz and others.) Koningsberg, 1746.

Allgemeine Naturgeschichte und Theorie des Himmels, &c. (Universal Natural History and Theory of the Heavens, &c.) *Ibid.* 1755.

Principiorum primorum cognitionis metaphysicae nova dilucidatio. A Dissertation on taking his Master's degree, in 1755.

Betrachtungen über den Optimism. (Reflections on Optimism.) Koningsberg, 1759.

Von der falschen Spitzfindigkeit der vier syllogistischen Figuren. (On the sophistical subtlety of the four syllogistic figures.) 1763.

Einzig möglicher Beweisgrund zu einer Demonstration des Daseyns Gottes. (The only possible evidence for demonstrating the existence of the Deity.) Koningsberg, 1763.

Beobachtungen über das Gefühl des Schönen und Erhabenen. (Observations on the feeling of the Beautiful and Sublime.) 1764. This tract is remarkable on account of the spirit of humour and pleasantry which pervades it.

Träume eines Geistersehers, erläutert durch Träume der Metaphysik. (Dreams of a Ghost-seer, illustrated by the dreams of Metaphysics.) Riga, 1766. This publication was occasioned by the visions of the famous Emanuel Swedenborg.

De Mundi Sensibilis atque Intelligibilis Forma et Principiis. Koningsberg, 1770. An inaugural dissertation on obtaining his professorship.

These, along with a number of other tracts, in which the author displayed an intimate acquaintance with the principles of the sciences, remarkable quickness of observation, great depth of thought and acuteness of reasoning, will be found incorporated in the following collections.

Kant's *Sämmtliche kleine Schriften.* (Kant's Smaller Tracts collected.) 3 Vols. 8vo. Koningsberg and Leipsic, 1797.

Kant's *Vermischte Schriften, mit Anmerkungen, von Tieftrunk.* (Kant's Miscellaneous Writings, with Notes, published by Tieftrunk.) 3 Vols. 8vo. Halle, 1799. A fourth volume was added, Koningsberg, 1807.

The early and anonymous essays of Kant were collected and published by F. T. Rink, Koningsberg, 1800. In the following works, his peculiar views of metaphysical science, as constituting what has been called the Critical Philosophy, are more fully and systematically developed.

Critik der Reinen Vernunft. (Critical Enquiry into the Nature of Pure Reason.) Riga, 1781. 3d Ed. 1791, 8vo.

Prolegomena zu einer jeden künftigen Metaphysik, &c. (Prolegomena to every Future System of Metaphysics, &c.) 1783. In the *Critik der reinen Vernunft*, the author had proceeded synthetically; in this other work, he adopts the analytical method, with the view of rendering his theory more intelligible to students.

Metaphysische Anfangsgründe der Naturwissenschaft. (Metaphysical Elements of Natural Philosophy), 1786. This is a systematic text-book on pure physics, in which the author treats of those principles in natural philosophy of whose truth we are conscious, *a priori*, *i. e.* independently of experience. The subject is treated under the four heads of Phoronomy, Dynamics, Mechanics, and Phenomenology.

Grundlegung zur Metaphysik der Sitten. (Fundamental Principles of the Metaphysics of Morals.) 1785.

Critik der Practischen Vernunft. (A Critical Enquiry into the Nature and Laws of Practical Reason.) 1788.

Critik der Urtheilskraft. (A Critical Enquiry into the Faculty of Judgment.) 1790. In this work, the author developes his views of the principles of taste.

Metaphysische Anfangsgrunde der Rechtslehre. (Metaphysical Elements of Legal Science.) 1797.

Metaphysische Anfangsgrunde der Tugendlehre. (Metaphysical Elements of Ethics.) 1797.

Anthropologie, in Pragmatischer Hinsicht. (A Pragmatical Treatise on Anthropology.) 1798

The following works were published from his papers by his friends:

Logik (Logic), published by G. B. Iäsche, 1801.

Physische Geographie (Physical Geography), of which, we believe, there have been several editions, by different editors.

Pädagogik (Pædagogics, or the Art of Communicating Instruction). Published by F. T. Rink, 1803.

(H.)

Kent.

Extent and Boundaries.

KENT, a maritime county in England, and, reckoning its population, extent, and fertility, perhaps the first in the island. It is in a peninsular form, being bounded by the British Channel on the south, by the German Ocean on the east, by the river Thames, which divides it from Essex, on the north, and by the counties of Surry and Sussex on the west. Its length is sixty-six, and its breadth thirty-six miles. The area is calculated to be 1300 square miles.

Divisions and Population.

The divisions of Kent are into five laths, which are subdivided into 63 hundreds and 15 liberties, and contain two cities, 36 towns, and 414 parishes. By the census of 1811, the inhabitants were returned as 373,095; viz. 183,500 males, and 189,595 females. The baptisms of the preceding year, of 6538 males, and 6295 females; the deaths, 5653 males, and 4174 females; the marriages, 3405. The families were, 76,235, of whom 27,077 were employed in agriculture, 27,966 in trade and manufactures, and 21,192 in neither of those branches of industry.

The places containing more than 2000 inhabitants are,

Towns.	Houses.	Inhabitants.
Canterbury,	2,199	10,200
Rochester,	1,551	9,070
Maidstone,	1,745	9,443
Deptford,	3,522	19,833
Dover,	3,973	19,128
Woolwich,	2,446	17,054
Greenwich,	2,381	16,947
Chatham,	2,221	12,652
Deal,	1,350	7,351
Lewisham,	1,165	6,625
Margate,	1,280	6,126
Tunbridge,	942	5,932
Sheerness,	840	5,318
Tunbridge Wells,	653	4,349
Ramsgate,	898	4,221
Folkestone,	784	3,697
Faversham,	638	3,655
Dartford,	531	3,177
Gravesend,	527	3,119
Cranbrook,	522	2,994
Bromley,	479	2,965
Tenterden,	456	2,786
Sandwich,	530	2,735
Ashford,	422	2,532
Milton,	401	2,470
Hythe,	277	2,318
Goudhurst,	277	2,082
Northfeet,	372	2,031

The places whose population is betwixt 1000 and 2000 are, Eltham, Bexley, Crayford, Lenham, Lydd, Westerham, Sittingbourne, Wye, and Malling. The inhabitants of towns are 206,160. Kent returns eighteen members to the House of Commons, viz. two from the county, and two each from Canterbury, Dover, Maidstone, Hythe, Rochester, Queenborough, Sandwich, and Romney.

The appearance of Kent is generally acknowledged to be equal, if not superior, in beauty, to that of any other British county. Its surface is gently undulating; none of its hills, except on the coast, rise abruptly, nor reach a great elevation. In all the vallies, there are streams of water; the woods and trees enrich the scenery, and the mixture of pasture and corn land, interspersed with orchards, fruit trees, and hop plantations, give to its beauties a character of softness and grace.

Rivers.

The Thames may be considered a Kentish river, as it washes its whole northern boundary, and empties itself into the sea on its shores. The river next in importance is the Medway, formed by the junction of four small streams, one only of which rises within the county. It becomes navigable for large barges at Tunbridge, continues its course by Maidstone to Chatham, where ships of the largest size can approach the shore; and there terminates its course, by joining the Thames at the Nore, beyond the arsenal of Sheerness. The Greater Stoure, the Lesser Stoure, the Rother, the Cray, the Darent, and the Ravensbourne, are small rivers, none of them navigable, but all of great benefit, by the fertility they communicate to the meadows on their banks, and by the power they afford to the many mills erected upon them.

Agricultural Districts.

Kent is almost exclusively an agricultural county, and though the soil is generally fertile, and though there are few extensive tracts of barren or uncultivated land, yet no part of the kingdom exhibits within so small a compass so great a variety of soils, of productions, and of modes of cultivation. It has been judiciously divided into eight districts for the purposes of agricultural description. The first of these, the Isle of Thanet, is in the north-west angle of the county. The soil is a light mould, on a chalky bottom, and has been highly enriched by the marine substances that have been administered as manure. The whole island contains 23,000 acres of arable and 3500 acres of rich marsh land. The most common rotation of crops is fallow, sometimes with sometimes without a crop of peas; this is followed by barley, clover, and wheat, and on some soils rather heavier, the course pursued is beans, wheat, and barley. The barley of this district is very much esteemed, and sought for as seed in other countries. Besides the common grains, seeds of various kinds are raised for sale to the London seedsmen, particularly canary, radish, spinach, mustard, and onion seed. The soil in the marshy parts of the island is a mixture of clay, sea-sand, and small shells, and yields most abundant pasture.

Isle of Thanet.

Upland Farms of East Kent.

The upland farms of East Kent, which surround Canterbury and extend to Dover on one side, and Ashford and Rochester on the other, are an open and dry tract of corn land, intermixed with woods. The soils are very various, all resting on a subsoil of chalk. Some of them are very heavy loamy clays, with a great quantity of flint-stones on the surface; these are usually cultivated on a four course rotation of fallow, barley, beans, and wheat; when the soil is somewhat stiffer, a variation occurs of fallow, wheat, beans, and oats. In this district, the harvest usually commences from twelve to fourteen days later than in the Isle of Thanet. The woods in this district usually supply poles to the hop-planters in the vicinity; they are cut down after from ten to fourteen years growth. There are in this division some few hop-grounds, but they are confined to three or

Kent.

Rich Flat Lands.

four parishes. In the vicinity of Sandwich, Feversham, and Deal, a portion of land, of a rich sandy loam, receives an almost uniform cultivation; it is nearly all under the plough, and a four course rotation is practised of wheat, beans, barley, and oats, after a fallow, or sometimes canary occupies the place of wheat; some portions of this land is alternately cropped with beans and wheat, or beans and canary. In the vicinity of Sandwich are many orchards, whose apples are partly sent to London, and a part furnishes return cargoes to the vessels that come laden with coals from Newcastle and Sunderland.

Hop Ground Division.

The district extending from Maidstone to Canterbury, and from thence to Sandwich, is the great garden tract for the growth of hops. The soils on which hops are produced are very various; the most productive are those which have a deep loam surface, with a subsoil of deep loamy brick earth, some of these have a considerable quantity of flint-stones mingled with the soil, and when it becomes compact almost covering it. Another soil, provincially called stone shalten, is very good for the growth of hops; it is mixed with many small portions of stone and sand, and rests upon the basis of the stone called Kentish-rag, which is burnt into excellent lime. The cultivation of hops is a very fluctuating pursuit, as the produce varies in different years from two to fifteen hundred weight *per* acre, and the prices have varied from three to fifteen pounds. The expence of cultivation is very great, from the quantity of manure that is required, from the great expence of the poles round which the plants twine, and the labour of keeping the ground clear and of picking the hops. Besides hops, the district is very productive of apples, cherries, and filberts, to the growth of which many fields, from one to ten acres in extent, are devoted; part of the apples are made into cider, the remainder, with the cherries and filberts, are principally conveyed to the different markets in London.

Isle of Shepey.

The Isle of Shepey is separated from the rest of Kent by an arm of the sea called the Swale, which is navigable for ships of 200 tons burden. Its length is eleven, and its breadth eight miles. About four-fifths of the island is either marsh or dry pasture land; on the former many oxen are fattened, and the latter are appropriated to the breeding and feeding sheep. About 10,000 acres of this island is arable land, of great fertility, usually cultivated with beans and wheat in alternate years, with occasionally a fallow before the beans. This land is highly fertile, the wheat raised on it is considered the best that is brought to London, a bushel frequently weighing 64 lbs. This great productiveness may be in a great measure owing to the practice of applying to the natural heavy clayey soil a frequent dressing of the cockle shells which are washed on the beach by the sea. It is not unusual to apply thirty cartloads of these shells to an acre of land.

Uplands of West Kent.

The Uplands of West Kent are extensive and various in their soils. This part is more woody and inclosed than East Kent. The ridge of the chalk hills, about six or seven miles in breadth, is a stiff clay, with many surface flints, and requires six horses frequently to plough it. On these soils the most common rotation is a year's clean fallow, then wheat, clover, wheat, and oats. Many large flocks of South Down sheep are kept on this hilly range. The vallies and the sides of the hills are lighter soil and easier to work, but do not produce better corn; some of this, but not to a great extent, is cultivated to hops.

Kent.

Weald of Kent.

The district known as the Weald of Kent was, in former times, an immense forest, desolate of inhabitants, and only occupied by wild swine and deer; and though it is now filled with towns and villages, and well peopled, the woods that remain are extensive; these exhibit some pleasing landscapes, where seats, farms, and villages, are mixed with cultivated fields, and woods of spreading oaks. The roads in this district are very bad, many of them impassable for carriages in the best seasons, and, in winter, horses can only travel by keeping on the narrow paved tracts that are formed by the sides of the highways. The soil is principally clay, with a substratum of marl, in some places very heavy, but in others sufficiently light to be ploughed with oxen. This district produces wheat, oats, barley, rye-grass, clover, and beans, but so various are the rotations, that it is scarcely possible to generalise them. The pastures are very rich and fertile, and fatten annually great numbers of cattle. In the western part of this district, and in the adjoining Weald of Sussex, there were formerly many iron-works; the ore is found, and the abundance of wood made the manufacturing of it profitable, but the substitution of coke for charcoal in making iron, has put a final stop to all the iron-works of Kent and Sussex.

Romney Marsh.

The last agricultural division is a rich level extensive tract of land, on the southern coast, containing about forty-five thousand acres of the richest pasture in the united kingdoms. This level is protected from the violence of the sea, and from inundations, by a dike of earth of very great thickness, called Dimchurch-wall. The whole is alluvial land, consisting of a fine soft rich loam, with portions of sea-sand and broken shells intermixed. The subsoil consists of alternate layers of sand and clay mixed with shells, among which are sometimes found large oak trees in various positions, the wood of which is as black and as hard as ebony. On this plain there are two towns, Romney and Lydd, but scarcely any villages, and few other houses but those of the shepherds and herdsmen who attend upon the numerous cattle that graze on the marshes. As there are no other fences but dikes, or posts and rails, from the surrounding heights it has the appearance of one large verdant field covered with sheep and oxen. The breeding and fattening of sheep is the principal purpose to which this level is appropriated, and the number bred is greater than on any other tract of the same extent in the kingdom. The sheep take their denomination from the district; they are larger than the South Downs, but not of a size equal to the Lincolnshire sheep. Their flesh is highly esteemed in the London markets, and their wool is both fine and of a long fibre; the average weight of the fleeces is about five pounds.

Landed Property.

The landed property of Kent is much divided; there are some noblemen that have large, but none

Kent.

such vast estates as to give a preponderating political influence. The number of freeholders exceeds ten thousand, enjoying estates from the smallest value that can give a vote, and gradually rising to L.7000 or L.8000 *per annum*. The copyhold tenures are very few, and the peculiar tenure of Kent, known as *gavel-kind*, is very much diminished by various legal operations.

Private Manufactures.

The *private* manufactories bear no proportion to the extent, wealth, or population of this county. The cloth trade, which was first introduced at Cranbrook, has entirely forsaken the county. A few descendants of French Protestant refugees carry on the manufacture of the richest brocaded and other silks. The best writing paper is made in the vicinity of Maidstone, and some near Westerham. There are some silk mills at Sevenoaks. At Crayford are extensive calico printing and bleaching works. At Dartford are mills for manufacturing iron. Such are the few private manufactures, none of which are extensive; but those of *government*, in this county, give employment to vast numbers of workmen. The greater part of the implements of land and sea warfare are prepared in Kent. The establishment at Woolwich, for the artillery, is certainly the most extensive and best regulated collection of various workshops and storehouses in the world. Mortars and brass cannon are cast, bored, and mounted, the different kinds of shot and shells prepared, and all the various combustibles used in war completed. The whole establishment under the Board of Ordnance, including the Academy for the instruction of the cadets, the Artillery Barracks, and the Arsenal, exhibit the wealth of the country, and the power of the government, in directing that wealth to the purposes of war.

Military Arsenal.

Naval Arsenals

There are four naval arsenals in Kent, viz. Deptford, Woolwich, Chatham, and Sheerness. In the three last of these, first-rate ships of war are built, and at Deptford the largest two-deckers. In this latter place is the principal store-house for provisions for the navy,—the slaughter-house, where, in time of war, hundreds of bullocks and pigs are killed; also possessing proper places for curing their flesh for future consumption. When the whole coast of the opposite continent was in the hands of a hostile nation, it was deemed advisable by the government to create a more considerable arsenal, where a fleet might at all times be ready, or, if necessary, be repaired, so as to oppose the force, without waiting for any change of wind, that was collecting in the Scheldt. A plan was then formed for constructing at Purfleet a naval arsenal upon a most magnificent scale. It has been begun by excavating the chalk rocks; and though the altered condition of Europe may make such an establishment less necessary, it is still in progress, though not proceeding rapidly.

Greenwich Hospital and Observatory.

One of the proudest ornaments of the nation, Greenwich Hospital, for the relief of disabled or aged seamen, is in this county; and, in the park contiguous to it, the Royal Observatory, to which the eyes of all the navigators of Europe are directed, as the place from which issues the nautical Ephemeris, that all nations depend on when traversing distant seas.

Kent || Kerguelen's Land.

Commerce.

Though Kent is bounded on three sides by the ocean and the River Thames, it has scarcely any foreign commerce. The harbours are none of them good; those of Dover and Ramsgate are formed by artificial piers, and the former is dry at low-water when the sluices are open. The only trade from Dover is to Calais, Dunkirk, and Ostend, for such light goods as can bear the expence of land-carriage. There is a herring fishery conducted from Folkstone; besides which, the principal foreign trade consists in smuggling those various articles, whose high duties offer a temptation to encounter such perilous adventures.

The sea-shores in this county invite numerous visitors, who frequent and fill various towns during the warm months of summer. The principal of these are Margate, Ramsgate, and Broadstairs; but, besides these, many of the smaller places on the coast are resorted to for purposes of health or amusement. On the western side of the county, the waters of Tunbridge have been long celebrated; and though the influence of fashion has erected into rivals several other Spas, yet the company that still resort to it is both numerous and respectable.

See Marshall's *Survey*; Boys's *Survey*; Brayley's *Beauties of England and Wales*; and Hasted's *Kent*. (w. w.)

KENTUCKY. See the Article UNITED STATES.

KERGUELEN'S LAND, or ISLAND OF DESOLATION, an island in the Southern Indian Ocean (long. 69° 30′, east lat. 49° 20′ south), discovered by Kerguelen, a Frenchman, and visited in the year 1779 by Captain Cook, who gave it the latter name, from its appearance. This land occupies about one degree and a quarter of latitude, and probably about two of longitude. The French discoverers imagined it to be the projecting part of the supposed southern continent, since proved to have no existence. The following observations on its natural productions were made by Mr Anderson, surgeon to Captain Cook:—Perhaps no place hitherto discovered, in either hemisphere, under the same parallel of latitude, affords so scanty a field for the naturalist as this barren spot. The verdure which appears when at a little distance from the shore, would flatter one with the expectation of meeting with some herbage, but in this we were much deceived; for this verdant colour is produced only by one small plant, not much unlike some sorts of saxifrage, which grows in large spreading tufts, to a considerable way up the hills. It grows on a kind of rotten turf, which dried, in cases of necessity, might serve for fuel, and is the only thing we met with here that could possibly be applied to this use. There is another plant growing plentifully about the boggy declivities, to near the height of two feet, and not much unlike a small cabbage, when it has shot into seed. Two other plants were found near the brooks and boggy places, which were eaten as sallad; the one resembling garden cresses, and very fiery; the other very mild; this last, though but small, is in itself a curiosity, having not only male and female, but what the botanists call *androgynous* plants. A coarse grass grows in some spots, about the sides of

the harbour, and a smaller sort, which is rarer. In short, the whole catalogue of plants does not exceed sixteen or eighteen, including some sorts of moss, and a beautiful species of lichen, which grows upon the rocks higher up than the rest of the vegetable productions; nor is there even the least appearance of a shrub in the whole country. The animals found here are all of the marine kind, and use the land only as a resting place, and for breeding; the most considerable are seals; no other quadruped, either of the sea or land kind, was seen; but a great number of birds, viz. ducks, petrels, albatrosses, shags, gulls, and sea-swallows. The hills are of a moderate height, yet many of their tops were covered with snow when the island was visited by Captain Cook, though it was in the month answering to our June. Rain must be almost constant here, not only from the marks of the torrents, but from the disposition of the country; which, even on the hills, is an entire bog. The foundations of the hills are composed chiefly of a dark blue, and very hard stone, intermixed with small particles of glimmer or quartz. Another brownish brittle stone forms here some considerable rocks; and one which is blacker, and found in detached pieces, incloses bits of coarse quartz. A red, a dull yellow, and a purplish sandstone, are also found in small pieces; and pretty large lumps of semi-transparent quartz, disposed irregularly in polyedral pyramidal crystals of long shining fibres. Some small pieces of the common sort are met with in the brooks, made round by attrition, but none hard enough to resist a file; nor were any of the other stones acted on by aquafortis, or attracted by the magnet. Nothing that had the least appearance of an ore or metal was seen.—*Edinburgh Gazetteer, or Geographical Dictionary.*

Situation

KERRY, a county in Ireland, situated on the south-west coast, between 51° 30 and 52° 24 north latitude. Its boundaries are the river Shannon on the north, the counties of Cork and Limerick on the east, and the Atlantic on the south and west. From north to south it extends about 60 English miles; from east to west 54; and its area, according to Smith's history of the county, is 1,030,193 English acres, or, according to Wakefield, 1763 square miles, or 1,128,320 acres. It is in the province of Munster, and archbishopric of Cashel. The sees of Ardfert and Aghadoe, between which it was formerly divided, were united to that of Limerick in 1663. The present divisions are eight baronies, and eighty-four parishes.

Extent

Divisions.

Sea-Coast.

The sea-coast of Kerry, from the river Kenmare on the south, to the estuary of the Shannon on the north, extends about 30 leagues. At both these places there is a sufficient depth of water, and good anchorage. The other bays are, Dingle, or Castlemain, and Tralee, with a number of smaller landing places, none of which are much frequented. Kenmare, Dingle, and Tralee, run so far up into the land as to form two peninsulas, which, projecting into the Atlantic, are terminated by several bold headlands, of which Dunmore, on the north of Dingle Bay, is perhaps the most westerly land in Europe. Dursey, Scariff, the Skeligs, Valentia, the Blasques, and the Magharees, are islands on the coast. Of these, Valentia and the Magharee islands are noted for their fertility, producing the best wheat and other kinds of corn in the district.

Surface

More than three-fifths of Kerry is mountainous and waste; and, at the time of Young's *Tour*, in 1779, did not yield to its proprietors more than 3d an acre. The southern quarter, from Kenmare to Dingle Bay, with the exception of some narrow tracts on the banks of the former river, is almost entirely composed of high grounds, among which Macgillycuddy's Reeks rise to the height of 3000 feet, and Mangerton to about 2700. These mountains are chiefly occupied with young cattle and goats; sheep, apparently the most profitable animal in such situations, are neither numerous nor of a valuable kind; and the little cultivation to be found here is so generally performed with the spade, that, in some entire parishes, as Mr Young assures us, there was not a single plough. To the north of Dingle Bay, about Tralee and Castle Island, the country becomes more productive, and much of the land is employed in keeping dairies, the produce of which, chiefly butter, is sent to Cork and Limerick, yet here, as in the rest of the district, marshes and bogs occupy a large proportion of the surface.

Soil.

The prevailing soil in the low grounds is clay, of different qualities; some of it seems to be a species of pipe clay, and other sorts might be converted into bricks and earthenware. Marl and ochre have been found in several places. Limestone, sandstone, and marble of different colours, but all variegated, are very common. Slates, of a good quality, are found on the side of a mountain near Killarney; and in the same quarter are copper mines, which were worked with considerable success in 1808, but discontinued in 1811. Iron ore, though found in great plenty in the southern baronies, is of little value, owing to the want of wood and coal. Lead has been discovered in several parts, but does not appear to be wrought. The *Lapis Hibernicus*, or Irish slate, is found near Castle Island; crystals, called *Kerry Stones*, many of them so hard as to cut glass, are got among the cliffs and rocks of the coast; and very fine amethysts near Kerry-head, on the south side of the entrance to the Shannon.

Waters

The principal streams are, the Blackwater, which, for some distance, forms the boundary with Cork; the Feal, which rises on the borders of Limerick, and unites with the Gale and the Brick to form the Cashin, which is rendered navigable for small vessels by the tide; the Mang, which receives several streams in its progress, from the mountains on the confines of Cork, where it has its source, towards the sea, is navigable to the bridge at Castlemain, a little above the bay of that name; the Lea is a small stream that falls into Tralee Bay; the Flesk enters the Lake of Killarney, of which the Laune is the only outlet. In the mountain districts, there is a number of brooks, which swell to considerable torrents after heavy rains, but the only stream of any note in this quarter is Kenmare, which gives its name to an arm of the sea near the southern boundary. Most of these and the other rivulets of Kerry abound with trout, and several of them with salmon. Besides the celebrated Lakes of Killarney, for which see KILLARNEY, in the

Kerry. *Encyclopædia*, Kerry contains several considerable pieces of fresh water. Lough-Quinlau, on its southern boundary, is remarkable for its floating islands. Mineral waters have been found near the town of Killarney, in the barony of Ineragh on the coast, in the northern barony of Iraghticonnor, near Dingle, at Castlemain, and at Tralee, the last of which, according to Smith, has been found of great benefit in several disorders.

Fish. Kenmare and the Bay of Dingle are frequented by a great variety of fish, and oysters and other shell-fish abound in their creeks and harbours, and at the mouth of the Shannon. Herrings visit the coast in August and September. The sea-calf, *vitulus marinus*, the *sepia* or cuttle-fish, the *urtica marina* or sea-nettle, are found on the coast; the first in great numbers on the shores of the Kenmare, where they are very injurious to the salmon-fishery.

Estates. Kerry is divided into estates very large, both in extent and value, some of them, according to Mr Wakefield, worth L. 30,000 a-year. Leases are in general for thirty-one years and three lives, and a considerable portion of the whole county is let to partnership tenants. Few of the tenants in the north quarter about Kerry-head occupy so much land as to require them to employ labourers; they pay their rents by the sale of butter and pigs, and by turf which they carry to Limerick. It is the practice for farmers to hire large tracts which they stock with cows, and these cows are then let out to dairymen, upon such terms as leave them but a very small return for their labour. The best corn land is about Tralee, and towards Dingle, where more flax is raised than in any other part of the county. In the neighbourhood of Tralee, land lets as high as 10 guineas the Irish acre.

Products. The principal articles which Kerry affords for export are its raw produce, beef, butter, hides, and tallow. It does not raise more corn than is necessary for its own consumption, and carries on no manufacture for sale, but that of coarse linen, which is only on a small scale. It has orchards, from the produce of which cyder is made; but little timber and not many plantations. Towns. The towns are Tralee, the county town; Dingle; Killarney; Ardfert; Castle Island, and Listowel. Tralee, which contains about 7000 inhabitants, and Killarney 5000, are the most considerable. Representation. The county, in which Lord Kenmare's influence preponderates, sends two members to Parliament, and the borough of Tralee, of which Sir Edward Denny is patron, a third. Population. The population, in 1792, is stated by Beaufort at 107,000, but it is understood to be considerably greater at present. In 1733, the Catholics were to the Protestants as twelve to one; but according to Mr Wakefield's information, the Catholic population is now one hundred to one. One half of the non-commissioned officers of the militia, and five-sixths of the privates, are Catholics. Prices. In 1811, the wages of common labour were 1s. a-day; potatoes 4d., and oats 10d. *per* stone; beef and mutton 5d. *per* pound; milk 2½d., butter milk, in summer 1d., and in winter 2d. *per* quart.

* See Smith's *History of Kerry*, and the works of Young, Beaufort, Newenham, and Wakefield, quoted under the former Irish counties. (A.)

Kerry || Kildare.

Situation. KILDARE, an inland county of Ireland, bounded on the north by Meath, on the east by Dublin and Wicklow, on the south by Carlow, and on the west by King's and Queen's Counties. Extent. It is about 41 miles long, and 27 broad, and contains 242,245 Irish or 392,397 English acres; of which four-fifths are arable, meadow, and pasture, and the remainder bog. Kildare forms part of the province of Leinster, its see is in the archbishoprick of Dublin; and the divisions are baronies and half baronies, of which there are fourteen in all, subdivided into 113 parishes.

Surface. Part of the Bog of Allen and other similar tracts occupy a large portion of the western side of this county. The surface is varied by a number of small hills and gentle declivities, but for the most part it is flat and nearly level, and when viewed from a commanding station, presents a rich, and on the banks of its rivers, a beautiful landscape. The Curragh of Kildare, extending to about 5000 acres, has been long celebrated for the softness of its turf, and the fineness of its pastures. But the climate of Kildare is said to be more moist than that of any other part of Ireland, which, if the statement be correct, is a very unfavourable circumstance, as a clay soil prevails very generally, and much of it is exceedingly tenacious of moisture.

Rivers. Kildare is watered by several streams, of which the most considerable belong to other counties. The Liffey entering it from the county of Dublin, to which it returns, traverses its north-east quarter in a circular direction. The Boyne, which rises within this county, in the Bog of Allen, and washes it on the north-west, does not become a considerable stream till it has passed into Meath. The Barrow has its sources in part from the same bog, and flows in an opposite direction through the south-west quarter. Canals. Kildare has the advantage of an inland navigation by the grand canal, which entering it from the north-east, proceeds in a west and north-west direction, till it passes into King's County. At Lowton a branch of this canal leaves the main trunk, and advances to the town of Athy, on the south-west boundary, and from this the navigation is continued southward on the River Barrow, which, soon after leaving Athy, becomes the boundary with Queen's County. The Royal Canal also passes through the northern quarter from east to west, and then enters the county of Meath on the north-west.

Estates. There are a few large estates in Kildare, particularly the Duke of Leinster's, which extends over a third of the county; and several proprietors, according to Mr Wakefield, have from L.6000 to L.7000 a-year. Yet many are less considerable, and property seems to be more divided here than in most of the other districts of Ireland.

Farms. The common size of farms is from 10 Irish acres to 200, and these farms are frequently held in partnership. Larger farms, however, are less rare here than in the arable tracts of the other counties. The leases were formerly for thirty-one years, but are now mostly for twenty-one years and one life. All parish and county taxes are paid by the tenant.

Kildare || Kilkenny.

With few exceptions, the course of cropping is the same as it has been for a century, viz. fallow, wheat, oats. Potatoes are universally cultivated. Oxen are employed in ploughing, and horses for carriages; but in many instances oxen and horses are mixed together in the plough team, which sometimes consists of six, and never less than four animals. A number of mules are also kept on the farms. The rent of the arable and pasture land in 1807 was estimated at a little more than 20s. the Irish acre, or about 12s. the English.

Towns, &c. Kildare has no large towns. Athy on the Barrow in the south-west, and Naas on the north-east, are alternately the assize towns; the others are Kildare, Monasterevin, Castle Dermot, on the south and west, and Leixlip, Maynooth, and a few others, on the north and east. At Cellbridge on the Liffey, a woollen manufactory was established some years ago by a company from Yorkshire. In the Catholic seminary at Maynooth, about 200 students are accommodated with lodgings, commons, and instruction. Each student pays a small sum as entrance-money, which, with his other expences, may amount to L. 20 a-year; the charges of the establishment being chiefly supported by an annual grant from Parliament.

Representation, &c. The county, in which the Duke of Leinster is the greatest freeholder, sends two members to Parliament, but Kildare has no parliamentary boroughs. The population, in 1790, was 56,000, but is said to be now nearly doubled. In 1811, taking the inhabitants thoughout, the Catholics were in proportion to the Protestants as thirty to one. In the same year wages and the prices of necessaries were higher than in most other parts of Ireland, common labour being quoted by Mr Wakefield at 1s. 6d. a-day for men, and 10d. for women and children; and in hay and corn harvest 2s. 8d. Potatoes were 5d. a stone, beef and mutton 6d. *per* pound, oatmeal 18s. per cwt. milk per quart 2d., and butter-milk ½d. in summer, and ¾d. in winter.

Wages and Prices.

See Rawson's *Statistical Survey of Kildare*, and the works already quoted under the Irish counties. (A.)

Situation. KILKENNY is an inland county in the Province of Leinster, in Ireland, bounded on the north by Queen's County and Carlow, on the east by Wexford, on the south by Waterford, and on the west by Tipperary. The Barrow flows along the eastern boundary, and the Suir on the southern, forming the lines of separation between Kilkenny and the counties of Wexford and Waterford. Kilkenny, the county town, is in north latitude 52° 35′, west longitude 9° 50′. According to the agricultural survey, its area is about 510,000 English acres, which is divided into nine baronies, besides the liberties of the towns of Kilkenny and Callen, and one hundred and forty-seven parishes.

Extent.

Surface, &c. The general appearance of this county is mountainous, yet there are some rich and beautiful tracts on the banks of the Barrow and the Suir, and also on the Nore, which flows through its centre; and several romantic wooded glens, watered by mountain streams. It is ornamented by a great many gentlemen's seats; and its flat districts, where the tillage farms are more extensive than in most parts of Ireland, present a prospect very different from what is often met with in that country. Much of the soil is incumbent on limestone; no great portion is occupied with bogs, of which, however, there are some considerable tracts near Urlingford and Callen on the west side; and the climate is said to be less humid than that of Dublin and Wicklow, which lie to the north-east, although the west winds prevail for about two-thirds of the year. During summer the thermometer ranges between 70° and 75°, and seldom sinks below the freezing point in winter.

Kilkenny.

Coal, &c. Coal has been wrought for many years in Kilkenny. The largest colliery in Ireland is at Castle Coomer, near the northern boundary of the county. It is a stone coal, raised in immense pieces, but of a sulphureous quality, which renders it disagreeable, and sometimes noxious, and it is, therefore, less fit for being used in families. For this reason, and also from the great expence at which it is raised, English coal is used in preference, even within a few miles of the works. There are several quarries of marble, chiefly of a black colour, of which a few tons are exported; and also quarries of excellent sandstone. Manganese, and iron and lead ores, have been observed in different parts. Jasper, of a deep red colour, in pieces of 10 or 12 inches long, and half as broad, has been found on the estate of Sir Edward Loftus, near the extremity of the granite district, between the Nore and the Barrow. There is a chalybeate spring of some celebrity at Ballyspellin.

Estates. Kilkenny contains several large estates, and many of a moderate extent, not exceeding a rental of L. 2000 a year. The principal proprietors are Lords Besborough, Clifton, and Ormond. The leases are in general for three lives, and partnership leases are common, though prohibited on one of the largest properties. On this estate the tenant is allowed to transfer his lease to one individual, but not to divide his farm. In 1809 the rent which might have been got, if all the leases had then expired, was estimated at 40s. or 42s. the acre, equal to about 25s. the English acre.

Dairies. Of the husbandry of this county, the most important department is the dairy, which extends over the greater part of it. The most considerable dairies are in the district called the Welch or Walsh mountains, a tract of dry grassy land fit for tillage, but still in its natural state, and not inclosed. Above 2000 Irish acres of this land were held in 1800 by one family, who kept 120 cows. The cattle are not for the most part housed in winter, and only those that are about the time of calving get a little hay on the fields, where the horses also are kept all the year. They fatten pigs to the weight of five cwt. The produce of the best dairies is 1½ cwt. or three firkins of butter *per* cow, and each cow requires from 1½ to 3 Irish acres. The practice of letting cows to dairymen, which is common in Munster, is but little known in Kilkenny, the cows belonging to the dairymen themselves, who, in some situations, breed them on their own farms, and in others prefer buying them at a proper age. Too little attention is paid to cleanliness in these dairies, especially in the northern district; and for this reason, according

Kilkenny.

to Mr Wakefield, though Irish butter, when fresh, is preferable to any in Europe, yet it "is in the lowest estimation in the London market, as it is almost always heavily salted, and very frequently tastes smoky, fishy, and tallowy." The cattle of this county are a mixed race from the native breed and the English long-horned, and their sheep have been in some parts improved by the introduction of the Leicesters. The Merinos have been introduced within these few years by Messrs Nowlan, the proprietors of a woollen factory, who have now 600 of the pure race, and they find that both the quality and the weight of the fleece have improved since the sheep were imported. The same corn crops are raised here as in other parts of Ireland, but clover and other green crops not in a suitable proportion. It is the custom to work oxen intermixed with horses, in teams of six, or three pair deep, the oxen placed foremost. Yet the fallows are better managed here than in any other part of Ireland. Irrigation has been practised for many years, but not extensively.

Salmon Fishery.

The rivers of this county, the Suir, the Barrow, and the Nore, have been long celebrated for their salmon, but the quantity, particularly in the Nore, has decreased very much within the last 50 years. They are now sent to Dublin packed in boxes with ice, as is done in Scotland, for the London market, a practice said to have been borrowed from the Chinese. The salmon peal, a fish resembling the salmon, but not so large, is also found in the Nore.

Manufactures, &c.

The most important manufacturing establishment in Kilkenny, and perhaps in Ireland, is the woollen factory of Messrs Nowlan and Shaw. These gentlemen not only produce superfine cloths, of acknowledged excellence, but the arrangements which they have adopted in carrying on the various processes are so peculiar, and have been so successful, as to render their works, like those of Mr Owen at New Lanark in Scotland, an object of very general curiosity and interest to strangers. Mr Radcliff, the secretary to the Farming Society of Ireland, has recently described these in a *Report* to that Society, which has been reprinted in the *Farmer's Magazine* for August 1820. In the town of Kilkenny there is a manufactory of blankets; and a few years ago there was a school there for teaching lace-making. The Suir, on the south boundary, is navigable for small vessels to Clonmell, and the Barrow, on the east, to Carlow, where it meets a cut from the grand canal to Dublin. These rivers afford great facilities both to the internal and export trade of the district. The Nore is also navigable from the Barrow, into which it flows, to the town of Thomastown, within a few miles of the town of Kilkenny.

Towns.

Kilkenny, the county town, contains a population of 15,000. (See KILKENNY in the *Encyclopædia*.) The other towns are Gowran, Thomastown, Callen, Knocktopher, and Inistioge. The population of the county, in 1800, was 100,191, of which only 731 families, or 4886 individuals, were Protestants. Five Catholics are called on the grand jury. Kilkenny is the only town that returns a member to Parliament, and two are sent from the county.

Population.

See Tighe's *Agricultural Survey of Kilkenny*, and the general works referred to under the Irish counties. (A.)

Kilkenny ‖ Kincardineshire.

KINCARDINESHIRE, or, as it is frequently called, the Mearns, a county in Scotland, situated between 56° 43′ and 57° 5′ north latitude, and 1° 47′ and 2° 30′ west longitude, from Greenwich, is bounded on the east by the German Ocean, on the north by the river Dee and Aberdeenshire, and on the west and south by the county of Angus or Forfar. It is of a triangular form, extending 32 miles from south-west to north-east, and where broadest, 24 miles from south to north, and contains 380 square miles, or nearly 243,444 English acres, besides about two miles of lakes.

Situation.

Extent.

Surface.

About the half of the area of this county consists of hills and heaths, of little value; somewhat more than a fourth is in regular cultivation, and the remainder is partly improveable land, and partly planted. The most productive land lies along the coast from the town of Stonehaven to the river North Esk, which forms the boundary with Forfarshire, and in the *How* (hollow) of the Mearns, a continuation of the valley of Strathmore, a district which lies to the westward of the coast lands, and immediately south from the Grampians. The Grampians, comprising a third of the area, stretch through its whole breadth from west to east, and, with very few exceptions, are exceedingly sterile and rugged, and very thinly inhabited. About three miles from the coast, this tract rises to the height of from 500 to 600 feet, after which a succession of dark brown hills rapidly increase in altitude, till, at the western extremity of the county, about twenty miles from the sea, the highest of them, Mount Battock, springs to the height of 3500 feet.

Climate.

The climate of Kincardineshire varies much in its different districts, but is, upon the whole, more rigorous than that of other parts of Scotland in nearly the same latitude. This is chiefly owing to a large proportion of its surface being occupied with the Grampians, on some parts of which snow remains all the year. According to tables given in the *Agricultural Survey*, the averages of the years 1805, 1806, and 1807, afford a medium of 43.8 of heat, 127 days of rain, 30 of snow, and 208 of dry weather.

Minerals.

There is no coal in this county, and limestone is far from being abundant. Native iron, in detached pieces, has been found at Balnakettle, in the parish of Fettercairn, where there is no indication of iron ore. Granite, basalt, puddingstone, and sandstone, are the prevailing rocks, especially the first, of which, with few exceptions, the Grampians are composed. Blocks of granite are scattered over the surface, particularly on the north; and much of the soil in this quarter has been formed from the decomposition of this rock. Along the coast, south from Stonehaven, there is a very fertile soil, consisting of decomposed basalt, or *rotten rock*, as it is called; and here also is a soil remarkably full of small round stones, which, though on this account a little more troublesome to cultivate, is nevertheless very productive. Puddingstone also abounds in this quarter; in the parish of Kinneff it is formed into millstones; in other places, it is in small pieces, which sometimes falling out of the precipitous front which much of the sea coast

Kincardineshire. assumes, leave convenient recesses for the incubation of sea-fowls. Sandstone prevails in the tract along the coast, and also in the *How* of the Mearns, the soil of which is a loam of various qualities, but generally fertile, and of a colour resembling that of the sandstone, which is for the most part red or grey. Moss, moor, and beds of barren gravel abound even in the lower parts of the county. The banks of the Dee, on the north boundary, are well covered with wood; and in the *How* there are many thriving plantations; but much of the coast lands are naked, and the Grampian district, throughout its whole extent in this county, has an aspect remarkably gloomy and desolate. The hill of Cloachnabane, 2370 feet high, is distinguished by a mass of naked rock upon its summit, from 80 to 100 feet in perpendicular height, which, when viewed from a short distance, has much the appearance of the ruins of a fortification.*

The rivers are the Dee, which flows for about eight miles through the northern part of the county, and is the boundary for fourteen miles more between this and Aberdeenshire and the North Esk, which for about ten miles separates it from Forfarshire. Of the other streams, none of which are considerable, the principal are the Cowie, the Carron, and the Bervie, which fall into the sea; the Luther, which joins the North Esk; and the Dye, the Avon, and the Canny, which discharge themselves into the Dee. The Loch of Drum, partly in Aberdeenshire, and the Loch of Leys, both in the Dee side or northern district, each of them between two and three miles in circumference, are the only lakes worthy of notice. In the Loch of Leys there is a small artificial island, founded on piles of oak, on which are the ruins of an edifice, about which tradition is silent.

In 1807, Kincardineshire was divided among eighty proprietors, including two communities, fifteen or sixteen of whom held in feu. According to the *Agricultural Survey* of that year, the large estates had been long in the same families, two of them for 650 years, and about two-thirds of the whole county had been thus possessed for more than a century. In 1811, the number of estates was eighty-six, and of the freeholders seventy-three. The valued rent is L. 74,921, 1s. 4d. Scots, about a fourth of which then belonged to estates held under entail; and, in the same year, the rent of the lands, as returned under the property-tax act, was L. 159,895, 19s. 2d., and of the houses L. 9235, 2s. Sterling. The cultivated parts are in general divided into farms of less than 200 English acres, among which there are many spots, held directly from the landlords, of only five or six acres. In the hilly districts the farms are necessarily large, but of so little value, that some extensive tracts in the Grampians, from the abundance of game, afford a higher rent, when let out to sportsmen for the season, than could be got from farmers. The rent of corn land may be from 20s. to 25s. an acre, though much of it is higher. Few of the leases are for more than nineteen years, and many of them are for shorter periods.

Farm

Agriculture. Modern agriculture has not made such general progress in Kincardineshire, as in the more southerly counties of Scotland, yet nowhere have proprietors (among whom the late Mr Barclay of Urie was, in this respect, the most conspicuous) incurred a greater outlay *per* acre in the improvement of land. In some instances, the removal of stones, preparatory to cultivation, has cost about L. 20 an acre. All the different kinds of corn, pulse, roots, and herbage grown in Scotland are cultivated here. Upon the pastures of the arable land the stock of cattle kept is nearly at the rate of one for every Scots acre, but five acres of the high lands are required for the support of a single sheep.

Towns and Villages. The towns and villages of Kincardineshire are but few in number, and small in respect to population; and its manufactures are inconsiderable. Stonehaven, the county town, is situated on the coast, about fourteen miles from Aberdeen; the town, with the parish of Dunottar, in which it stands, contained, in 1810, 1886 inhabitants, who are partly employed in rope-making, and in the manufacture of canvas and osnaburgs. Bervie, or Inverbervie, a royal burgh at the mouth of the Bervie, about ten miles south from Stonehaven, employs about two-thirds of its population, amounting, in 1811, to 927, in the same manufactures, with the addition of a soap-work, a spinning-mill for lint, a bleachfield, and a thread factory. Gourdon, the sea-port of Bervie, about a mile and a half to the south-east, is a small place, chiefly occupied by fishermen. The village of Johnshaven, four miles south of Bervie, contained about 1000 inhabitants, partly mechanics, and partly seamen. Laurencekirk has about 1300 inhabitants, and is noted for its beautiful varnished snuff-boxes, made of wood. At Inverie there has been a woollen manufactory on a small scale for several years. The other villages are Auchenblae, Marykirk, Fettercairn, St Cyrus, Drumlethie;—a few others for fishing are scattered along the coast.

Commerce. The external commerce of the county, besides its trade in sheep and cattle, consists chiefly in the import of timber, coal, and lime, and the export of grain and fish, at the ports of Stonehaven, Gourdon, and Johnshaven. In 1807, Stonehaven had 8 vessels, of from 30 to 150 tons; Gourdon 6 vessels, carrying in all 192 tons; and Johnshaven 12, amounting to 197 tons; and about 300 hands were employed in the white-fishery, from villages spread over a line of coast extending from Aberdeen to Montrose, a distance of 37 miles. The value of the fish caught was estimated at L. 6000. The salmon-fishing belonging to this county, on the North Esk and the Dee, and on the Water of Bervie, was then let at about L. 2700 a-year.

Antiquities. Among the antiquities of Kincardineshire the most worthy of notice is a Roman camp, remarkably entire, near the mansion house of Fordoun; Fenella's Castle, about a mile and a half west from Fettercairn, where there are the remains of a vitrified wall; and Dunottar Castle, long the residence of the Earls Marischal, about a mile south from Stonehaven, on a peninsula, projecting into the sea. The regalia of Scotland were deposited in this castle during the civil wars of the seventeenth century.

Parishes, &c. Kincardineshire contains eighteen entire parishes, and part of three more, two of which are partly in Aberdeenshire, and the greater part of the third in Forfarshire. The parishes to the south of the Gram-

pians, thirteen in number, form the Presbytery of Fordoun, which belongs to the Synod of Angus and Mearns, the rest are attached to the Presbyteries of Aberdeen and Kincardine O'Neil. In conjunction with Angus, this county furnishes a regiment of militia, and a few years ago, it raised two regiments of volunteers, which were afterwards formed into one regiment of local militia, containing 816 rank and file. The county sends one member to Parliament, and Bervie, its only royal burgh, unites with Aberdeen, Brechin, Arbroath, and Montrose, in electing a member for the burghs. The population in 1800 and 1811 will be seen from the annexed abstract.

See *Beauties of Scotland*, Vol. IV.; Robertson's *General View of the Agriculture of Kincardineshire; The General Report of Scotland*, Vol. I.; and Playfair's *Description of Scotland*, Vol. II. (A.)

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
5,688	6,179	302	12,104	14,245	7,924	6,023	12,210	26,349

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
5,718	6.349	283	12,580	14,859	3,071	2,059	1,219	27,439

KING'S COUNTY, an inland county in the province of Leinster in Ireland, bounded by Meath on the north, Kildare and Queen's County on the east, Tipperary on the west and south-west, and Galway, from which it is separated by the Shannon on the west. From east to west, its general length is about seventeen Irish miles, its greatest breadth, from north to south, thirty-one, and it contains, within an outline of one hundred and thirty miles, seven hundred and fourteen English square miles, or about 457,000 English acres. Almost the half of this consists of bogs, mountains, and waste, and the remainder is arable, meadow, and pasture of a medium quality. It is divided into eleven baronies, and fifty-two parishes, the latter belonging to the sees of Kildare, Killaloe, Meath, Clonfert, and Ossory.

Extent.

Divisions.

Surface.

The form of this county is very irregular. Its breadth on the western side is suddenly contracted by Queen's County on the south-east, and further to the east, by Kildare and Meath. A small district of it is entirely surrounded by Kildare. The interior is, with few exceptions, a dead flat, though considerably elevated. The only mountains are those of Sliebh Bloom on the boundary with Queen's County, a range which extends for about fifteen Irish miles, and has but one pass, called the Gap of Glandine, which is steep, craggy, and very narrow. The Bog of Allen occupies a considerable tract on the north-east.

Soils, &c.

The soil of the arable land is, for the most part, either moorish or gravelly, the former tolerably productive in dry, and the latter in moist seasons, but neither of them naturally fertile. Limestone, and limestone gravel, the means of their improvement, abound every where. The pastures, though in many parts fine, are not luxuriant; better adapted for sheep than cattle, and very favourable to the growth of fine wool. Much of the mountain district has an argillaceous soil, thickly interspersed with rocks of sandstone, and a deep irreclaimable bog often occurs at its base; but towards the centre of this range, where limestone prevails, there is much good pasture, and here the base of the hills, which is composed of a stiff clay, produces abundant crops of corn. The only streams worth notice, besides the Shannon, on the western boundary, and the Barrow, which for a small distance separates this from Queen's County, are the two rivulets, Brosna, which fall into the former. The Boyne also touches this district on the north-east. There is only one small lake, Lough Pallis: another, Lough Annagh, is partly in Queen's County. The canal from Dublin to the Shannon passes through the county from east to west, along its whole length. The minerals and fossils, hitherto discovered, are iron ores in small quantity, manganese, ochre, marl, chalk, and potter's clay, with sandstone, limestone, and limestone gravel, already mentioned. Mineral waters occur in several places.

Estates.

King's County is divided into large estates, and many of their owners do not reside; but much of the land is held on leases, in perpetuity, and the

King's County.

holders of these form a respectable class. The principal proprietors are Lords Digby, Ross, and Charleville.

Farms.

Farms were formerly very large, not unfrequently of the extent of 2000 acres, but their size has been diminished, and such as are considered large do not now exceed, on an average, 400 English acres. Many are as small as twenty acres, though the medium size of the smaller class may be double this. Most of the arable land is tolerably inclosed, chiefly with hedges of whitethorn, which grows here to a great size. Partnership leases and subtenancy are less common than in some other parts of Ireland. Yet the condition of the tenantry and the peasantry does not seem to be materially more improved. The farm buildings of every description are generally very bad, the cottages in particular; and yet those who have been long accustomed to these miserable cabins, are said to prefer them to more comfortable dwellings, which, after having been erected by some of the proprietors, were for some time allowed to stand unoccupied. In other respects, also, there is little difference to remark between the condition of the lower classes in this and the Irish counties before described. The English language is pretty general; the peasants speak both that and the Irish with almost equal facility.

Wheat, o[illegible] barley, and potatoes, are the most common cro[illegible] Reducing the Irish acre and corn measures to [illegible]lish, the average produce of wheat is stated [illegible] *Agricultural Report* to be no more than sixteen bushels; of barley and oats, it is about thirty-two bushels; [illegible] of potatoes, only four tons *per* acre. Both ox[illegible] and horses are employed in labour; the plough [illegible] sometimes drawn by only two of either, in a few [illegible]stances by two heifers. Yet this and their othe[illegible] [illegible]plements are not generally of a good constructio[illegible] The thrashing machine has [illegible] in the district for about twenty years. Limestone gravel is much used as a manure, with the best effects, both on tillage and grass lands.

The leases were formerly for thirty-one years or three lives, but the more common period of late is twenty-one years, to which the life of the tenant in possession at the end of it is frequently added. Some tenants hold for lives renewable for ever, paying a renewal fine equal to half a year's rent or more on the fall of every life. Modern leases often contain a prohibition against alienating. Nothing is so much complained of among the tenantry as the mode in

Tithes.

which tithes are collected. "I really apprehend," says Sir Charles Coote, the author of the *Agricultural Report* for the county, "it would be a very difficult matter to mislead the lower orders of the country folk, was there a reasonable modification of tithe; and they seem one and all discontented, not so much with the institution, as the severe mode of collecting the tax, which is here unusually oppressive." The incumbent, Sir Charles thinks, is not to blame; but he lets the tithe to a proctor, and the proctor relets, or transfers his lease to another, and so on, till the person who at last collects the tithe, and necessarily pays a heavy rack-rent, has every inducement to exact it with the utmost rigour.

Manufactures.

There is no manufacture carried on here to any considerable extent. That of linen is the most general, yet not upon a large scale. There are breweries and distilleries at which the greater part of the oats and barley grown in the county are consumed, little of either being used in the food of the lower classes. Coarse woollens are made for their own clothing, as in other parts of Ireland.

Towns.

The market and post-towns are Banagher, Philipstown, the county town, Balliboy, Birr or Parsonstown, Tullamore, Edenderry, Shinrone, and Clara. Philipstown and Banagher returned two members each to the Irish Parliament, but none of the towns are represented in the Parliament of the United Kingdom. The only members are two for the county. According to Wakefield, the Catholics are to the Protestants as eight to one.

Population.

In 1801, the population was estimated at 76,000; it is said to be now about 130,000.

See Sir Charles Coote's *Agricultural Survey*, 1801; and the *Works* of Young, Beaufort, Newenham, Wakefield, and the *Statistical Account of Ireland*, formerly referred to under the Irish counties.

(A.)

Kinross-shire.

Situation.

KINROSS-SHIRE, a county in Scotland, bounded on the north-east, east, and south, by the county of Fife, and on the north and west by Perthshire, is about twelve miles in length from east to west, and ten miles in breadth from south to north, but

Extent.

according to the latest survey, contains only 78 square miles, or 49,9[illegible]0 English acres, being one of the smallest counties in Scotland. Kinross, the county town, situated nearly in the centre, is in north latitude 5[illegible]° 1[illegible]′, and west longitude from Greenwich 3° 10′.

Surface.

Kinross-shire is the highest level ground in the peninsula, formed by the Forth and the Tay, which was formerly called Ross, or the promontory, and included the counties of Fife, Kinross, and Clackmannan. From this county the waters flow in every direction. The soil is in general dry, inclining to gravel, with considerable fields of moss, and some clay and loam. The productive land may extend to 30,000 acres, or about three-fifths of the whole. It contains several

Lochleven.

lakes, of which Lochleven, in the vicinity of Kinross, is the most considerable. This lake, which is about fifteen miles in circumference, and covers an area of 33[illegible] acres, contains several islands, which abound in trout, eels, pikes, perches, and flounders. The castle of Lochleven, in which Queen Mary was confined, stands on one of these islands, about two acres in extent. Several rivulets flow into this lake, of which the principal are the Gairny, the South Queich, and the North Queich; and the River Leven, the only stream of any note in the district, issues from its eastern extremity, and, after passing through a considerable part of the county of Fife, enters the Frith of Forth at the town of Leven. The prevailing rocks are whinstone, sandstone, and limestone. Coal has been found on the estate of Blair Adam; it is wrought at Kelty, in the parish of Cleish, on the southern boundary of the county.

Estates.

Kinross-shire is divided into a number of small estates. Only about ten proprietors hold of the Crown; the others hold of these freeholders, the lands having been let out to them, for the most part

Kinross-shire ‖ Kirkcudbright.

about the end of the seventeenth and beginning of the eighteenth century, for payment of a feu-duty. Hence, over the greater part of the county, every single farm is a separate property, possessed for the most part by its owner. The valued rent is L.20,250, 1s. 3d. Scots; and the real rent, according to the *Agricultural Survey*, published in 1814, is L.14,541, 10s. Sterling. In 1811, the number of freeholders was only fifteen. When the land is let out to tenants, the leases are from fourteen to twenty-one years, except in the neighbourhood of the villages, where they are for a shorter period; and the rent is paid partly in money, and partly in grain, or according to the price of grain. The size of the farms is from 100 to 300 acres. A great proportion of them is always in grass, for which both the soil and climate are favourable; and much of the land is inclosed either with stone-walls or hedges. The principal corn crops are oats and barley, or big; wheat, though partially cultivated, does not enter into the regular course of cropping. Potatoes, turnips, and clovers, with rye-grass, are raised in every part of the county. On the banks of the Gairny and the Leven, there are meadows of considerable extent, which yield abundant crops of hay. The pastures of the cultivated land are occupied by cattle; sheep are kept in numbers only on the Cleish hills, and on that part of the Ochills which belong to this county. Not much of the district is under wood. The most considerable plantations are on Blair-Adam, the estate of the Lord Chief Commissioner Adam, and they are in a very flourishing state.

Farms.

Villages.

The only villages in this county are Kinross and Milnathort, the former containing, in 1811, a population of about 1500, and the latter 900. At both these places several fairs are held in the year, but there is no weekly market. Nothing that deserves the name of manufactures is to be found here, except that a few weavers are employed by the manufacturers of Glasgow. Assessments are resorted to for the poor of the villages; but those of the country parishes are relieved by voluntary contributions.

Representation, &c.

Kinross-shire sends a member to Parliament alternately with the county of Clackmannan. Both counties are under the jurisdiction of one sheriff, who has a substitute for each. There are only four entire parishes, viz. Cleish, Orwell, Kinross, and Portmoak, with portions of other three; the first three belong to the Presbytery of Dunfermline, and the fourth to that of Kirkaldy, both under the jurisdiction of the Synod of Fife. The population in 1800 and 1811 is given in the annexed abstract. By the returns for the last of these years, there are about 93 inhabitants to the square mile.

See *Beauties of Scotland*, Vol. IV.; *General Report of Scotland*, Vol. I.; Playfair's *Geographical and Statistical Account of Scotland*, Vol. I.; Dr Graham's *General View of the Agriculture of Kinross and Clackmannan*; and, for its antiquities, Sibbald's *History of Fife and Kinross*. (A.)

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
1,372	1,686	37	3,116	3,609	667	888	5,170	6,725

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
1,364	1,680	53	3,466	3,779	428	640	612	7,245

Situation.

KIRKCUDBRIGHT, a county in Scotland, situated between 54° 43′ and 55° 19′ north latitude, and 3° 33′ and 4° 34′ west longitude from Greenwich, is bounded on the north by the shires of Dumfries and Ayr; on the east and south by the Solway Frith and the Irish Sea; and on the west by the county of Wigtown. It is in length from east to west about 48 miles, varying in breadth from 30 to 17 miles, and contains 882½ square miles, or 564,480 English acres. This district is commonly called the *Stewartry*, not the shire, of Kirkcudbright, and its judge, whose powers and duties are the same as those of a sheriff, is called *Steward*. The appellation of stewartry had its rise in the ancient tenure by which it was held, and the subsequent forfeiture of its lords; but the distinction between stewartry and sheriffdom is in this case purely nominal. Kirkcudbright is one of the two counties comprehended under the general

Extent.

Kirkcudbright.

name of Galloway; Wigtonshire on the west being the other.

Surface.

About two-thirds of the surface is mountainous. A range of mountains stretches along the whole northern boundary in the form of a vast amphitheatre, embracing nearly half the county; on the boundary with Ayrshire they are not much inferior in height to any in the south of Scotland. There are also some considerable mountains on the southern extremity, such as Criffel, 1831 feet high; Cairnsmuir, 2597; and Cairnharrow, 1110. The high lands are for the most part covered with heath, except on a part of the northern boundary, where a narrow tract of green hills run out between the shires of Ayr and Dumfries; and many of them are wet and mossy. In the middle of the district, the declivity is so gentle, that the river Dee, at thirty miles from its mouth, is only 150 feet above the level of the sea; yet, even in the interior, there is no great extent of level ground, the greater part of the surface being occupied by rocky knolls, steep banks, and hills of a moderate elevation. On the coast, also, hills rise almost everywhere, to the height of several hundred feet. The district is studded with a great number of lakes, of which there is one or more in almost every parish, though few of them are considerable. As there is little full grown wood, and the plantations are but partial, and for the most part of not many years' growth, the general appearance of the stewartry is that of a bleak exposed country, on which labour has been but recently employed, and where its efforts must always be confined to a comparatively small field. Yet it contains many spots of great natural beauty, particularly on the coast, where the sea in several places has formed deep bays, surrounded with high grounds, some of which are fringed with coppice.

The soil of the lower grounds is, for the most part, of a hazel colour, sometimes inclining to red, and seems to be chiefly composed of argillaceous schistus in a state of decomposition. It is seldom of any great depth, and the rock, often rising above the surface, gives a rugged and sterile appearance to much even of the arable land. This soil is, however, in many instances possessed of great natural fertility, not soon injured by wet seasons, and affords plentiful crops and fine natural herbage. Clay is of no great extent, and found chiefly on the banks of the rivers. The smooth round hills accessible to the plough have, for the most part, a close subsoil, here called *till*, and do not, therefore, admit of being profitably cultivated but after an interval of several years' pasturage. Tracts of moss, commonly from four to eight feet deep, extend over a tenth or twelfth part of the whole county.

Mineralogy.

Much of the mountainous district is composed of granite. According to the *Agricultural Survey*, there are three several districts of this rock, which occupy nearly a fourth of the surface. Strata of very dissimilar substances, to which Dr Hutton has given the general name of schistus, prevail in the lower parts. Some are of a hard compact grain, of a blue or greyish brown colour, for the most part breaking irregularly, but often in parallel plates, of which coarse slates have been made. With these are intermixed layers of a soft argillaceous stone, which readily yields to the weather, and is popularly known by the name of *slate band*. These rocks, which also occupy a large part of the district, are sometimes traversed by dikes of porphyry, and also by granite. In the neighbourhood of Dumfries, the prevailing rock is sandstone. Limestone is found at Kirkbean, on the Nith, the only place in the county where it is wrought; and there are also promising indications of coal on the estate of Arbigland, near Dumfries. In the parish of Colvend, on the Solway Frith, there is a quarry which affords millstones. Lead mines were wrought in Minnigaff, on the western boundary, for many years, but have been discontinued. Iron ore abounds, but, from the want of coal and wood, is of little value. On the estate of Mr Murray of Broughton, near Gatehouse, copper has been lately discovered, and is now working by an English company.

Rivers.

The rivers are the Nith, which separates this county from Dumfries-shire, for about nine miles on the north-east; the Urr, which flows south-east by the village of Dalbeaty, and is navigable five or six miles for small vessels; the Dee, the largest river, which enters Loch Ken, a lake almost in the centre of the county, about eight miles long, and in some places a mile in breadth, and giving its name to the river which issues from the lake, falls into the Solway Frith about five miles below the town of Kirkcudbright. It is navigable for two miles above the town for vessels of 200 tons. In spring tides the water rises about 30 feet at Kirkcudbright, where there is a well-sheltered natural harbour, of easy access. For the last seven or eight miles of its course the banks of the Dee are planted. St Mary's Isle, near Kirkcudbright, is a highly ornamented spot, and the Little Ross, a beautiful island, is situated at its mouth. The salmon fishery on this river was rented, some years ago, at L. 900. The Fleet is remarkable for the picturesque scenery on its banks, and is navigable for small vessels to the village of Gatehouse, four miles from the sea. The Cree, a more considerable river, separates this county from Wigtonshire, and flows into the bay of Wigton, from whence it is navigable to the small harbour of Carty, a little below Newton-Stewart. The stewartry is everywhere supplied with pure springs and rivulets. Chalybeate springs are also numerous, one of which, Lochenbreck, in the parish of Balmaghie, seven miles from Gatehouse, is said not to be inferior in medicinal virtues to any in the kingdom.

Estates.

The landed property is not divided into large estates. Out of 1043, their number in 1808, as given in the *Agricultural Survey*, 972 are stated to have been below L.500 a year. The valued rent, which was taken in 1642, is L. 114,637, 2s. Scots; the real rent, in 1808, was estimated at L. 167,125 Sterling; and in 1813 at upwards of L.200,000. Many of the smaller proprietors cultivate their own estates. According to the work just referred to, almost half the county is held under deeds of entail, many of which had been executed very lately.

Tenantry.

"The condition of the peasantry, at a period not very remote, seems to have been much depressed, and the state of husbandry rude and barbarous in

Kirkcudbright.

the extreme." (Smith's *Survey*.) And in both these respects the stewartry is still behind most of the other southern counties of Scotland. Yet it was here that the improvements of modern husbandry were adopted, at a time when they were entirely unknown in the greater part of the kingdom. So early as 1750 Mr Craik of Arbigland practised the drilling and horse-hoeing of the celebrated Tull, which he ever afterwards continued to follow in the culture of beans and turnips. He inclosed and drained his estate, cleaned his fields by fallowing, applied calcareous manures, introduced sown grasses into his course of crops, and worked his plough with two horses. A few of the other proprietors followed in his steps, but their efforts were not seconded by the tenantry at large. It is only since the end of last century that modern husbandry has made any considerable progress, and it is far from being yet general. A regular alternation of what are called white and green crops is not always observed, and turnips are not so extensively cultivated as potatoes, though the latter must always be a very unprofitable crop in a thinly peopled district. The chief crops are oats and barley, with wheat on the better soils. Unlike other hilly tracts in Scotland, the land is almost universally inclosed, chiefly with stone walls, called *Galloway Dikes*. These dikes are built close, or double, as it is called, for part of their height, and afterwards single, the stones in the latter part being laid in such a manner as to allow the passage of the light through the wall. But it is now becoming a common practice to build the whole of the wall double, and, after laying a course of stones that project a little beyond its breadth on both sides, it is completed by a coping of stones laid on edge and closely pinned.

Galloway Dikes.

Cattle, &c.

This county is chiefly celebrated for its cattle, which form by far the most important part of its agricultural produce. They are known in every part of Britain by the name of *Galloway cattle*. (See Agriculture in this *Supplement*.) Sheep are confined to the mountainous districts, where they are kept in great numbers. They are of the heath or black-faced variety, with coarse wool, and yield a very small return for the extent of their pastures, which, however, are in general of the very worst description in the south of Scotland, some large tracts being rented so low as 6d. an acre, or even lower. It has not yet become the practice to combine the rearing and fattening of sheep with the culture of arable land, by which the light soils of the other border counties have been rendered so productive. A small, hardy, and active race of horses, called *Galloways*, was formerly reared here and in Wigtonshire, the other division of Galloway, but a larger breed being required for the labours of modern husbandry, especially since two horse ploughs have become general, the old race is very rarely to be found in a pure state. The name, however, is frequently applied to horses below full size, wherever they are reared.

Roads.

The first road act for the stewartry of Kirkcudbright was obtained in 1779. At that period there was scarcely any thing that deserved the name of a road, except the military road from Dumfries to Portpatrick, which had been made about fifteen years before; but at present very few districts are better provided in this respect. The first good roads were made on the estate of the Earl of Selkirk, under the direction of his son Basil William, Lord Daer, to whom this county owes many other improvements. In 1796, by another act of Parliament, the assessments were allowed to be increased and tolls erected, and soon after a new road was made from Dumfries to Castle-Douglas, a distance of nineteen miles, through a hilly broken country, with so much attention to preserve the level, that it has seldom a rise of more than one foot in forty, and much of it is nearly a perfect level. All the principal roads made since have been done with equal judgment. The district is also well accommodated with bridges, of which the most considerable is one over the Dee at Tongland, about two miles above Kirkcudbright, which has an arch of one hundred and ten feet span. It is built of sandstone, brought partly from Annan in Dumfries-shire, and partly from the Isle of Arran, was finished in 1808, and cost upwards of L.7000.

Manufactures.

Manufactures have made little progress here. Those of soap and leather do not supply the wants of the inhabitants; paper is made at two small mills; and there are four cotton mills at Gatehouse, which have long ago ceased to be in full employment. In some of the towns and villages, a considerable number of weavers are employed by the manufacturers of Glasgow and Carlisle. Its commerce is confined to the export of cattle, sheep, wool, and grain, and the import of lime, coals, groceries, and manufactured goods, with wood from America, and occasionally wood and iron from the Baltic.

Towns and Villages.

Kirkcudbright, the county town, and a royal burgh, contained, in 1811, a population of 2760. It is pleasantly situated on the Dee, and is noted for the information and urbanity of its inhabitants. Societies have been formed here for a purpose rather unusual, namely, the building of houses, not for sale, but for the use of the members who compose them. Every member makes a small monthly payment into a general fund, which is employed in erecting the houses, and these, as they are finished, are assigned to the members by lot, those to whom they fall paying *5 per cent.* on the money which their houses have cost, in addition to their monthly payments; and this arrangement continues till all the members be supplied, and the societies dissolved. New Galloway, also a royal burgh, is situated at the head of Loch Ken, and contains only about 650 inhabitants. The principal villages are Creetown, at the mouth of the river Cree, on the bay of Wigtown; Gatehouse, twelve miles east from the former, on the river Fleet; and Castle-Douglas, formerly called Carlinwark, an inland place, about nine miles north-east of Kirkcudbright. The Galloway Bank was established at Castle-Douglas in June 1806. These three villages seem to be in a thriving state; the houses are for the most part of two stories, and, in other respects, they are superior to villages of the same extent in many other parts of Scotland. The others are Dalbeaty on the river Urr; Keltonhill, noted for its great cattle fairs

Kirkcudbright ‖ Klinometer.

in June and November; and Maxwelton, on the Nith, which, though in this county, belongs by its situation to the town of Dumfries, from which it is separated only by the bridge over that river.

Poor.

There are no regular assessments for the poor in the country parishes, but the ordinary kirk-session funds have been much augmented in some parishes, by charitable donations. Several sums have been also destined by individuals to the support of schools, particularly in the parishes of Borgue, Balmaclellan, and Dalry.

Representation.

The stewartry sends one member to Parliament, who is chosen by about one hundred and forty freeholders. In the elections for the burghs, Kirkcudbright joins with Dumfries, Sanquhar, Annan, and Lochmaben; and New Galloway with Stranraer, Wigtown, and Whithorn. It is divided into twenty-eight parishes, of which sixteen belong to the presbytery of Kirkcudbright, and two to that of Wigtown, both in the synod of Galloway, and ten to the presbytery and synod of Dumfries. An abstract of the census of 1800 and 1811 is given in the annexed tables.

Parishes.

Population.

See *Beauties of Scotland*, Vol. IV. which contains some notices of the history, and a pretty full account of the antiquities of this county; Smith's *General View of the Agriculture of Galloway*, 1810; *The General Report of Scotland*; and Playfair's *Account of Scotland*, Vol. I. (A.)

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
5,600	6,433	161	13,619	15,592	5,856	2,532	20,823	29,211

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
6,223	7,380	196	15,788	17,896	2,662	1,885	2,833	33,684

KLINOMETER, or CLINOMETER, (from Κλινω, which denotes inclination, and Μετρον,) the name of an instrument contrived by the late Lord Webb Seymour, a nobleman who devoted his life to the cultivation of science. This instrument is intended to be used by the geologist for measuring the inclination of stratified rocks, and the azimuth in which that inclination lies.

If a plummet-level be applied to an inclined plane in that position in which the edge or bore of the plummet-level is horizontal, and if the edge of the plummet-level be then turned round ninety degrees in the inclined plane, the angle formed by the plumb-line with the line which is perpendicular to the edge of the plummet-level, is equal to the inclination of the inclined line to the horizon. On the same principle the inclination of a plane to the horizon is measured by the Klinometer.

In the Klinometer, represented at Plate XCIV. Fig. 1, AC is a circular plate, the circumference of which is divided into 360 degrees; it has three short feet on its under surface, one of which is seen at S.

The feet on the under side of the plate are of wood, which is preferred to metal, as less liable to slip when placed on an inclined surface. The ends of the feet are in a plane parallel to the upper surface of the circular plate. The fibre of the wood is set perpendicular to the plate, to diminish the derangement which may happen by the expansion of the wood from moisture.

The arm CG is moveable round the centre of the circular plate. D is an oval hole through which is moveable the catch of a sliding bolt; this bolt passes on the under side of the circular plate; the catch of the bolt is made flush with the surface of the circular plate. The bolt serves to fix the axis C on the circular plate: when the instrument is to be used, C is the axis round which the arm CG turns. When the three short feet of the circular plate are placed on the inclined surface of a stratified rock, the arm which bears the spirit level EE is moved down to the lowest point of the quadrant DD, and the arm CG is moved round till the bubble stands in the middle of the level; the arm CG and the level are then in the intersection of the inclined stratum with a plane parallel to the horizon: the degree on the

Klinometer || Kookies.

edge of the circular plate at which the arm CG now stands is noted, and the arm CG is to be moved round through 90 degrees of the circular plate upwards; when the arm CG is arrived at this second position, it is in the line of the greatest inclination of the stratified rock. The arm which bears the spirit level EE is then to be raised, by turning it on the centre of the quadrant, and when the bubble stands in the middle of the level, the arm will indicate, on the limb of the quadrant, the degree of inclination of the stratified rock. The magnetic needle in the box OO will, at the same time, show the magnetic azimuth, formed by the vertical plane, which contains the angle of greatest inclination; and this magnetic azimuth is to be converted into true azimuth by applying the number of degrees that the needle varies from the true meridian, at the particular time and place where the observation is made. The box OO has both the top and bottom made of glass, so that the needle may be observed both when the instrument is placed on the upper surface, and when the instrument is applied to the under surface of an inclined plane. When the instrument is not in use, the arm CG, with the quadrant and compass, are unfixed, and taken off from the circular plate, by withdrawing the catch of the bolt which is seen at *d*. The compass box OO is turned round an axis, which is seen below the spirit level EE, so that the compass-box comes into plane with the quadrant, and then the quadrant, compass-box, and arm, CG, pack into a flat box. The circular plate ACS is now separate from the other parts of the instrument, and lies flat in another part of the box made for packing the instrument. Lord Webb Seymour's account of this instrument is published in the *Transactions of the Geological Society*, Vol. III. 1816. (Y.)

KOOKIES, or LUNCTAS, the name of a barbarous race, who live among the mountains to the north-east of the province of Chittagong, in Bengal. They are but little known to the inhabitants of the plains, with whom they rarely have any intercourse, except when they occasionally visit the markets on the borders of the jungles in the Runganeeah and Aurungabad districts, to purchase salt, dried fish, and tobacco.

Of all the various tribes which have yet come to the knowledge of the British in these mountains, the Kookies are perhaps the least civilized. Their chief employments are war and the chace; and, like all mountaineers who are of roving habits, and inured to fatigue, they are of an active muscular make, but not tall. They have the peculiar features of all the natives of Eastern Asia, namely, the flat nose, small eye, and broad round face. Their political union seems to be extremely imperfect, being divided into a number of distinct tribes, totally independent of each other, though they all acknowledge the authority of three different Rajahs. The power of these rulers, however, is very limited, excepting in the tribe with which they live, where it is absolute. The dignity is hereditary, and it belongs to the Rajah, in cases of general danger, to summon all the warriors to arms. Each tribe is under the command of its own chief, who is absolute both in war and peace, and has the power of life and death. This office is elective; though, in general, the chieftain is succeeded by his nearest relation.

Kookies.

The Kookies are armed with bows and arrows, spears, clubs, and *daws*, a species of hand-hatchet, which, in close combat, is a most destructive weapon. They have shields of cow-hide, and use various devices, in order to render themselves hideous to their enemies. Their villages are built on the steepest and most inaccessible hills, by way of precaution against any sudden attack. As a farther security, they are surrounded with a thick bamboo pallisade, and the passages leading into them strictly guarded both day and night, more especially if there is any suspicion of danger. But, in all cases, they are extremely unwilling to admit strangers within the limits of the fortification. Every village belongs to a tribe, which consists seldom of less than 400 or 500 inhabitants, and sometimes of 1000 or 2000.

This barbarous race is involved in perpetual hostility, not only from the quarrels of their Rajahs, but from the depredations committed on each other by the different villages, and their constant refusal to give up the guilty persons. In these cases a petty and destructive warfare ensues, which is carried on with all the secret stratagems and barbarous devices of savages. Their favourite plan is to approach their enemies secretly and by night marches; after they come within sight of their prey, they lurk in ambuscade till dawn, when they commence their attack with a great shout, striking their spears against their shields, and, in all cases where they are successful, they massacre indiscriminately man, woman, and child. On some occasions where they spare the children, they adopt them into their own families; and the only slaves among them are the captives thus taken.

The Kookies are of the most vindictive disposition, and, in all cases, they require blood for blood. To such a length do they carry the principle of revenge, that if a tiger should happen to kill any of them, the whole tribe sets out in pursuit of him, and they never rest until they kill this or some other tiger in retaliation. They are much occupied in the chace, and as they are restrained by no prejudice of cast or sect, they shoot indiscriminately all sorts of animals. Part of their attention is also directed to agriculture; but in this the women perform the chief part of the drudgery. They have no coins among them, and their trade is, in consequence, carried on by means of barter. They have an idea of a future state of rewards and punishments. But their notions are confused and superstitious, and they imagine that the surest road to the favour of the Deity is by destroying the greatest number of their enemies.

The *Asiatic Researches*, Vol. VII. contains an *Account of the Kookies, or Lunctas*, by John Macrae, Esq. whose information was derived from a native of the Runganeeah district, who, when a boy, was carried off by the Kookies, and succeeded, after a captivity of 20 years, in returning to his family.

(O.)

L A C

LACCADIVES, an archipelago of low islands lying off the Malabar, or western coast of India, between the 8th and 13th degrees of N. lat. There are nineteen considerable ones; but as most of them are surrounded with reefs and steep rocks, with a great depth of water close to them, the approach to them is very dangerous. Between these islands there are many channels, through which ships from India, bound to Persia or Arabia, frequently sail. The safest of these is called Mamale, or the Nine degree channel, which runs between the islands of Seuhilipar and Kalpenny. The largest of these islands is about 7 miles in length, and 2½ in breadth. Most of them are inhabited by a race of Mahometans called Moplays. They do not yield grain, but produce an infinite quantity of cocoa nuts, from the husk of which they form the *Coir* cables, which are more elastic and durable than hemp, as the sea-water, instead of rotting, preserves them. These islands are well supplied with fish, and carry on a trade with the small shells called *cowries*, which pass as coin all over India. They are nominally dependent on Cannanore; but their poverty has been always their chief security. They were discovered by Vasco de Gama, in 1499; but have been little frequented by Europeans.—*Edinburgh Gazetteer, or Geographical Dictionary.*

LAGRANGE (Joseph Lewis), a mathematician and astronomer of the first rank, born at Turin, 25th January 1736, was the son of Joseph Lewis Lagrange, treasurer at war, and Maria Theresa Gros, only daughter of a rich physician at Cambiano.

He was the eldest of eleven children, but nine of them died young. His family was of French extraction on both sides, and his French biographers have dwelt with pleasure on the minute particulars of their emigration, in order the more fully to authenticate their own claim to the honour of calling him their natural as well as adopted countryman. It was his great-grandfather that first settled at Turin, in the service of Emmanuel II., who married him to a Roman lady of the family of Conti. They had at one time acquired considerable affluence; but his father had ruined himself by his expenses and speculations; and Lagrange used frequently to observe, that he owed his own success in life to his father's misfortunes, since, if he had been rich, he should never have applied to the mathematics as a profession. The classics were at first his favourite study at the College of Turin: he began his scientific education with reading the works of the ancient geometricians, and at first preferred their methods of investigation to the more modern analysis; but being convinced, as it is said, by a paper of Halley in the *Philosophical Transactions*, of the superiority of the algebraical mode of representation, he applied with redoubled ardour, at the age of seventeen, to the study of the later improvements in the methods of investigation; and in his subsequent works, he abandoned, wherever it was practicable, all geometrical considerations, and seems to have valued himself on having produced a complete system of mechanics, free from the incumbrance of any diagram whatever. When he was only nineteen, he was made Professor of Geometry in the Royal School of Artillery, but not before he had exhibited, in his first publication, a specimen of the improvements which he was throughout his life to contribute to the mathematical sciences.

The friendships which he formed with his pupils, most of whom were his seniors, led to the establishment of a society which afterwards received the sanction of the royal authority, and to the publication of their memoirs, in which Lagrange not only took the most active part as a contributor of original papers, but also by materially assisting in the demonstrations of Foncenex, and promoting the researches of Cigna and Saluces. Foncenex was soon rewarded by being placed at the head of the maritime establishment which the king was then forming; and Lagrange received in a short time a still more flattering remuneration, in the panegyrics, which were liberally bestowed on him by his great rivals Euler and Dalembert: the former procured him, in 1759, the compliment of being made a foreign member of the Academy of Berlin, having become well acquainted with his merits by an epistolary intercourse, which began as early as the year 1754, when Lagrange communicated to him his first ideas of the solution of isoperimetrical problems, which Euler had the delicacy to allow him time to complete, before the publication of his own further researches on the subject.

In 1764, he obtained a prize from the Academy of Sciences at Paris for a memoir on the difficult subject of the libration of the moon, having treated it by an original method, derived from the principle of virtual velocities, which he afterwards applied so successfully to other branches of mechanics. Soon after this time he found an agreeable relief to the monotony and retirement of his life at Turin, in accompanying his friend the Marquis Caraccioli, who was appointed Ambassador at the Court of London, as far as Paris, where he had the delight of becoming personally acquainted with a number of the most distinguished mathematicians of the age, who were capable of appreciating his merits, especially with Clairaut, Dalembert, Condorcet, Fontaine, Nollet, and the Abbé Marie; but indisposition prevented his going on to England, as he had intended, and he returned to Turin after a short stay in France. A second prize, on the subject of the satellites of Jupiter, was awarded him in 1766; and the same tribute was again paid to his merit on three subsequent occasions. It was in this year that he was invited to Berlin, as a successor to Euler in the place of Mathematical Director of the Academy, Euler having been induced to remove to Petersburg, by a better prospect of providing for his numerous family. The appointment of President of the Academy, held by Maupertuis, had been given but in part to Euler; the whole was offered to Dalembert, who declined it; but both he and

Lagrange. Euler united in recommending Lagrange as the fittest person for the situation. It was, however, with some difficulty that he obtained his sovereign's leave to quit Turin; and the favour was at last granted to him partly in pique, on account of the terms of the invitation, which expressed the desire of the "greatest king in Europe" to have the greatest mathematician at his court.

At Berlin he pursued his career of study in tranquillity and without interruption, upon a competent income of about L. 300 a year, with the advantage of such demonstrations of the royal protection, as were still more important than income to his rank in society. The king seems to have preferred him to Euler, as more tolerant in his opinions, though by no means joining in all the innovations of the day, and rather avoiding every discussion relating to them, as well as any great familiarity with his patron. He was made, in 1772, one of the eight foreign associates of the Parisian Academy. He is said to have married more for the sake of complying with the universal custom of his friends and colleagues at Berlin, than for any desire of female society; and he invited a relation of his own from Turin, who became his first wife; but she was soon after carried off by a lingering disease. He was about this time very closely employed on his greatest and best work, the *Mécanique Analytique*; but it was with some difficulty that the Abbé Marie found a bookseller at Paris, who agreed to undertake its publication, and only upon condition of engaging himself to divide the loss, in case of failure in the sale. He also procured the valuable assistance of Mr Legendre as a corrector of the press.

Upon the death of Frederic, in 1786, Lagrange no longer felt the same interest in remaining at Berlin, though he was not treated by the new court with any thing like disrespect. While the ministers of Naples, Sardinia, and Tuscany, were making him offers on behalf of their respective sovereigns, Mirabeau persuaded the French ambassador at Berlin to recommend Mr de Vergennes to invite him to Paris; but it was in reality through Mr de Breteuil's interest, and at the suggestion of the Abbé Marie, that he was ultimately induced to settle there, in 1787, having received a grant of an income equal to that which he had enjoyed at Berlin, under the name of a veteran pensioner of the Academy, with a vote in its deliberations. He was kindly received by Marie Antoinette, on account of his connexion with Germany; and, until the Revolution, he had the use of apartments in the Louvre.

It was at this period of his life, when his success had been the most gratifying, and his fame had become perfectly established, that he appeared to suffer under a degree of melancholy or apathy, which was absolutely morbid. He confessed that all his enthusiasm was extinguished, and that he no longer felt the least relish for mathematical researches. He had not even the curiosity, for two years, to open the printed volume of his *Mechanics*, which he had never seen except in manuscript. It is a consolation to think, that this annihilation of his energies was only partial and temporary: he amused himself in the mean time with metaphysics, "with the history of religions," and of languages, and with medical and botanical, and especially chemical studies; and the alarms and agitations of the Revolution, which soon followed, instead of overwhelming his broken spirits, seem to have roused his dormant powers, and to have revived his satisfied ambition, exciting him to new labours and new triumphs. Lagrange

In 1791, his name appeared on the list of the foreign members of the Royal Society of London. Mr Maurice has asserted, that all the scientific bodies of Europe, *except* the Royal Society, received him with open arms: if the remark was intended as a censure of that society, it is right that its injustice should not pass unnoticed,

Notwithstanding the public embarrassments which attended the Revolution, Lagrange's pension was confirmed by the National Assembly, upon the proposition of Mr Dusèjour, in the most flattering manner: and when the depreciation of the currency materially reduced its amount, he received a partial indemnification, by being appointed a member of a committee for examining useful inventions, and afterwards a Director of the Mint, in conjunction with Berthollet and Mongez: but this employment he found too laborious, and resigned it six months afterwards. He was greatly interested, at this period, in the establishment of the new system of weights and measures: he was so violently bent on *decimation*, that he scarcely forgave Borda for having made a measure of a quarter of a metre, and he thought so little of the advantage of integral subdivisions, that he sometimes declared he should have preferred the number 11 to 12, for the very reason that it admitted no subdivision at all, and caused all lesser quantities to be expressed in units comparable to each other only. This opinion seems, however, to have been advanced rather as an exaggerated objection to the introduction of 12, which was suggested by some more ardent innovators, than as seriously attributing a real advantage to the employment of a prime number.

When the Academies were suppressed, the Jacobins purified the commission of weights and measures by striking out the names of many of its most distinguished members, while they retained that of Lagrange, probably because he was of no political party whatever, and had always been particularly cautious in expressing his sentiments of the events of the day. In October 1793, however, a decree was passed which ordered all persons, not born in France, to leave the country. Guyton, who was a member of the Committee of Public Safety, advised him to claim an exemption from its operation, by a requisition of that committee, on the pretext of his being employed in preparing a report on Dr Hutton's *Treatise on Gunnery*; and he actually received an injunction from the committee, requiring his stay, "in order to complete the calculations which he had undertaken respecting the theory of projectiles." He was attempting to reunite the experiments of Dr Hutton with a more correct theory than had before been applied to them; but he published nothing of importance on the subject. After the murder of Bailly and Lavoisier, he had agreed to return to Berlin, and to resume his former situation

Lagrange. there; and he was on the point of obtaining a pass port, and even a public mission from Hérault de Sechelles. But the establishment first of the *Normal School*, in which he was a professor, and then of the *Ecole Polytechnique*, induced him to remain at Paris, and again directed his activity into its ancient channels. In the Normal Schools the masters were mixed with their pupils, in order that the facilities of conversation might produce a developement of the subjects discussed in the most elementary manner that was possible: but the conversation was by no means supported in the form of incessant questions and answers: Lagrange's explanations were often interrupted by moments of silence, in which his inventive faculties were deeply engaged in reflection, and the whole of his powers were concentrated on a new train of ideas. It was amidst these discussions that the *Theory of Analytical Functions* originated: a work certainly not destitute of the marks of great mathematical talent, but which, when considered as a substitute for the method of fluxions and its kindred doctrines, resembles very much the suggested introduction of an undecimal in preference to a duodecimal scale of notation, with which the author had before amused himself.

Upon the re-establishment of the Institute, Lagrange was made one of the original members; and he was the first on the list of the Board of Longitude, which was then first instituted at Paris. He received about this time a compliment highly grateful both to his love of fame and to his filial affection, in the person of his father, then past 90, and continuing to reside at Turin. By the direction of Talleyrand, who was Minister for Foreign Affairs, the Commissary of the Directory in Piémont, attended by the generals of the French army, and several other persons of distinction, went in procession to congratulate this venerable person on the merits of his son, whom he had not seen for more than 30 years, whom they declared "to have done honour to mankind by the brilliancy of his genius, and whom Piemont was proud to have produced, and France to possess as a citizen." The old man lived to the age of 95, and was sincerely regretted by his son.

Under the Consular and Imperial government, Lagrange was made a Senator, a Grand Officer of the Legion of Honour, a Count of the Empire, and a Knight Grand Cross of the Order of Reunion, in addition to the personal marks of friendship and intimacy which Bonaparte habitually conferred on him at the meetings of the Institute, and on other occasions.

He applied with so much zeal to the republication of the first part of his *Mechanics* in 1811, and of his *Analytical Functions* in 1813, that his health is supposed to have suffered from the fatigue; which, in conjunction with a predisposition, not uncommon in advanced life, may very possibly have been the immediate cause of a fit that attacked him in the beginning of the latter year. In the month of March he was subject to frequent returns of fainting, accompanied by some fever. On the 8th of April he had a last conversation with Lacépède, Monge, and Chaptal, all the parties being aware that it was to be the last. He felt the approach of death, but he declared that it was in that form neither painful nor even disagreeable. He spoke with proper gratitude of the favours he had received from Bonaparte, who afterwards provided very liberally for his widow and his brother. The interview lasted more than two hours, and though his memory often failed him with respect to names and dates, yet his language was correct and energetic. He survived this effort only two days, and died on the morning of the 10th April 1813. He was buried at the Pantheon, or the church of St Géneviève, and his friends Lacépède and Laplace paid the last honours to his memory in a funeral oration.

Lagrange was habitually of delicate health, and extremely temperate in his diet and mode of life limiting his food almost entirely to vegetables, and taking his exercise very punctually in the open air. At the age of 56 he married the young and handsome Miss Lemonnier, who appears to have felt the splendour of his celebrity and the goodness of his heart, as affording much more than a compensation for the great inequality of their ages. He was deeply sensible of her affectionate attachment, which he considered as the greatest happiness of his life and on account of which alone he regretted its termination. He had no children, and he was perfectly contented to be without them. In the midst of the most brilliant societies he was generally absorbed in his own reflections; and especially when there was music, in which he delighted, not so much for any exquisite pleasure that he received from it, as because, after the first three or four bars, it regularly lulled him into a train of abstract thought, and he heard no more of the performance, except as a sort of accompaniment assisting the march of his most difficult investigations, which he thus pursued with comfort and convenience. He was less fond of the theatre, from which he often returned without knowing what piece had been represented. His manner in conversation was gentle and timid: he was more in the habit of interrogating than of giving his opinion, and his favourite expression was, "I don't know".... He was not, however, easily induced to change his sentiments when they were once fixed having generally adopted them upon mature consideration. As a writer, whenever any controversy occurred, he was always calm in defending himself, and respectful in speaking of his antagonists. Notwithstanding that his person was striking and characteristic as well as pleasing, he would never consent to have his portrait painted, thinking it unworthy of a man of intellectual excellence to wish to be remembered for the external form of his features. But a sketch of him was once obtained by stealth at a sitting of the Institute, and a mask of his face was taken after his death. His works bear witness, that for 54 years he occupied either the first or very nearly the first place among all the mathematicians of his age, and of all ages. "Of all the inventors, says Laplace, "who have the most contributed to the advancement of human knowledge, Newton and Lagrange appear to me to have possessed in the highest degree that happy tact, which enabled them to distinguish general principles among a multitude of objects enveloping them, and which is the true characteristic of scientific genius. This tact, in La-

Lagrange. grange, was united with a singular elegance in the method of explaining the foundations of the most abstract truths of analysis." Lagrange was a great admirer of Euler, who perhaps excelled him in the adroitness with which he employed the most refined artifices of calculation, though his views and methods were less original and less powerful. Dalembert was highly esteemed by Lagrange, as a man of abundant ingenuity and talent, though less accurate in his conclusions, and in his modes of reasoning, than either Euler or Newton. Newton he envied almost as much as he admired, for having found a system of the world in existence, and the principles of its modification not yet understood: but when it is remembered that the places of the heavenly bodies are now ascertained to seconds more nearly than they were to minutes during the life of Newton, it cannot be thought that Newton left too little for his successors to accomplish.

1. His first publication, at the age of 18, was, *A Letter to C. J. Fagnano*, 23d June 1754. It contains series for fluxions and fluents of different orders, somewhat resembling the binomial theorem of Newton.

2. The series of his papers in the *Miscellanies of Turin* is continued from 1759 to 1785. The first is *On Maxima and Minima. Misc. Taur.* I. 1759, p. 18. It is founded on the principles laid down by Maclaurin, and is illustrated by the case of the successive transmission of an impulse through a series of elastic bodies, comprehending the combination of a number of variable quantities. 3. *On an Equation of finite differences, and on the Theory of recurring Series*, p. 33. The equation is resolved by an exponential integral, and the sum of the series is obtained by the principles of fluxions: the same mode of calculation is also applied to the laws of chance. 4. *Researches on the nature and propagation of Sound.* End of the volume. The investigations of Taylor and of Newton were true and correct as particular solutions only of the problems of chords and of undulations, though mistaken for general solutions, and as such successfully combated by Cramer, whose reasoning, though certainly too far extended, is here approved by Lagrange. Daniel Bernoulli very successfully defended them both, not only as particular solutions, but as capable of being rendered universal by proper modifications and combinations. Euler had proposed a more general construction for the case of chords; Dalembert insisted that this method required a limitation to figures exempt from angles and from abrupt changes of curvature, and Lagrange is inclined to admit his exceptions. But, after all, the question is merely a metaphysical refinement, since no abrupt changes can ever occur in the actual form of a chord; and a chord affording a harmonic of unlimited acuteness will approach without limit to a mathematical angle. The author begins, in this essay, with considering the motions of a finite number of bodies, and then proceeds to the affections of a fluid, which he reduces to the same equations as are applicable to the motions of chords, and these he integrates in Dalembert's manner. He lastly examines the phenomena of the grave harmonics observed by Tartini, and explains them very satisfactorily from the analogy of the beats of discordant sounds. 5. *New Researches on Sound. Misc. Taur.* II. 1760–1. p. 11. The same subject is here continued, and extended to the divergence of sound, which had before been examined by Euler. The author now admits that there is no inconsistency in the demonstration of Newton and Cramer, which deduce the same velocity from different laws of the supposed motion, since the velocity is really uniform in all cases. The oscillations of a heavy chain are computed, and some remarks are made in conclusion respecting the sounds of flutes. 6. *On the Maxima and Minima of indefinite integrals*, p. 173. This essay contains the foundation of the method of independent variations, which has excited so much attention for the universality of its application and the utility of its results. It was received with distinguished applause by Euler, as fulfilling his own wishes for the extension of a similar method; and it was Euler who more fully explained its principles, and gave it the name of the method of variations, which has since been generally applied to it. In fact, however, the foundation of the method had long before been laid by Leibnitz, under the name of differentiation from curve to curve; and he had proved that the process of integration, with respect to one kind of variation, might be applied to the differentials or fluxions taken in another manner, without the necessity of first obtaining the fluent: and Euler had employed this consideration in treating of the geometrical properties of curves affording maxima or minima: but his method is less simple and less general than that of Lagrange, who first pointed out the universality of the principle, that the variation of the fluxion is equal to the fluxion of the variation, and showed its utility in many cases of such integrations, as leave the expression concerned still a fluxion of another kind: and in the mechanical application of the method, he made the fluxion of the ordinate of a vibrating chord represent its inclination to the axis at any given time, while its variation indicated its velocity or its change of place in successive intervals of time, and the fluxion of a revolving solid to relate to the magnitude of its different parts, while its variation depended on its rotatory velocity. The steps of the method are generally simple and easily understood, at least they may and ought to be rendered so; but the merit of the invention is not the less, because it admits of a very ready application, and because it might have occurred to a less distinguished mathematician; as indeed something nearly resembling it seems to have been employed by Fontaine in 1734, under the name of the fluxiodifferential calculus, in the investigation of a tautochronous curve. 7. It was particularly in demonstrating the law, which is called the law of the least action, that Lagrange completed the theory of variations, where Euler had felt its deficiency; and the application of the method to several *Mechanical Problems* constitutes the second part of the Memoir. p. 106. The author takes occasion also to correct an error of Dalembert, who had imagined that there was no necessity that the different strata of a given density, in a body like the earth, supposed to be in a state of

Lagrange. fluidity, should all be level, which, however, is here shown to be a necessary consequence of Dalembert's own equations. 8. *Addition to the memoir on Sound*, p. 323; admitting the difficulty raised by Dalembert, respecting the continuity of the figure of a chord, and acknowledging that the initial figure must not be supposed angular; while, in fact, as Mr Fourier has lately demonstrated, and as had been remarked many years ago in this country, an infinite series of harmonic curves may approach infinitely near to two right lines meeting in an angle. 9. *Problems relating to the integral calculus*, *Misc. Taur.* III. 1762–5, p. 179. A miscellaneous paper, containing remarks on the resolution of equations, containing fluxions of different orders; on some cases of the motions of fluids; on the vibrations of chords; on the properties of small oscillations in general; on loaded threads; on central forces; and on the theory of Jupiter and Saturn. 10. *An arithmetical problem*. *Misc. Taur.* IV. 1766–9, p. 44. This paper, dated at Berlin, contains a complete resolution of all equations of the second degree, having whole numbers for their roots; a problem, like most of those of Fermat, of more curiosity than utility, but well calculated to exercise the powers of minds like those of Euler, Lagrange, Legendre, and Gauss. The question, which is the particular subject of this paper, was proposed as a challenge by Fermat to his contemporaries in England, and correctly answered by Wallis, though without a very satisfactory demonstration. 11. *Integration of an Equation*, p. 98. A case in which the whole equation is integrable, though its parts, even when properly separated, are incapable of perfect integration. 12. *On the method of variations*, p. 163. In answer to Fontaine, and to Le Seur and Jacquier, who had attacked him in their Integral calculus. 13. *On the motion of a body attracted by two fixed centres*, p. 188, 216, including the effects of different supposed laws of attraction. 14. *On the figure of columns*, p. 123. This memoir contains an attempt to demonstrate that the cone is a more advantageous figure for the strength of a column than any conoid, and the cylinder than any cone. But the calculations are founded on the erroneous supposition, that the column must bend before it breaks; and, even upon this hypothesis, it appears possible to assign a stronger form than a cylinder, since the summit and the base of the cylinder must certainly contain some useless matter. 15. *On the mean of a number of observations*, p. 167; showing the advantage of taking the mean, from the theory of probabilities. 16. *On the impulse of fluids*, *Mém. Taur.* 1784–5, I. p. 75. The author observes, that this impulse will be measured by a column of twice the height due to the velocity, when the whole impulse of the jet is received by an obstacle, but of the simple height, when a limited surface is exposed to the force of a larger stream. 17. *On the integration of some irrational fluxions*, II. p. 218, involving the square root of an expression ascending to the fourth power of the variable quantity.

18. Some of the later of these papers are subsequent in date to those which are found in the *Memoirs of the Academy of Berlin*; but the order of enumeration is of little consequence. The first communication of Lagrange to the Academy, of which he was made director, is *On tautochronous curves*, *Mém. Berl.* 1765, p. 364. The paper is dated 1767; and it contains a completion of Fontaine's investigation of the subject. 19 *On the expected transit of Venus* 1766, p. 265. The author has here analytically investigated the curves of immersion and emersion for the different parts of the earth. But, as Mr Delambre observes, in order to arrive at the very easy and tolerably accurate solution previously given by Delille and Lalande, he is obliged to employ in succession several elaborate expedients, founded on some very subtile principles, accompanied by various transformations of his ordinates, while, by a trigonometrical calculation of a few lines, we may obtain a more complete formula, comprehending even the terms which he has neglected, and which, although very small, are not absolutely insensible. At the same time, he has certainly applied his formula to the calculation of the parallax of the sun, in a very convenient manner, which had accidentally escaped both Delille and Lalande, though it follows readily from the trigonometrical calculation. 20. *On indeterminate Problems of the second degree*, 1767, p. 165. This is the first of a numerous series of papers, relating to this difficult branch of analysis, which, notwithstanding its practical inutility, has afforded sufficient scope for the exertion of talent, to give celebrity to the names of Diophantus and Fermat among the most ingenious of mathematicians. 21. *On numerical equations*, p. 311. This subject was also much cultivated by the author at a subsequent period: he here finds an equation for the differences of the roots, and exhibits the result in the form of a continued fraction. 22. *Continuation of the memoir on numerical equations*, 1768, p. 111. The method of continued fractions is still further improved. 23. *On the resolution of indeterminate problems in whole numbers*, p. 181. 24. *On the resolution of literal equations by series*, p. 251. The contents of these memoirs have been principally merged in the author's later productions. 25. *On the force of springs*, 1769, p. 167. It is demonstrated in this interesting paper, that the force of a hair-spring approaches to the law of a circular pendulum, the more nearly as its length is greater. 26. *On Kepler's problem*, p. 204. An application of the methods explained in the last volume, especially of a very elegant formula for the reversion of series. 27. *On elimination*, p. 303. A refined and general method of exterminating a quantity from an equation, which, however, is somewhat intricate, even in the simplest cases. 28. *Remarks on isochronous curves*, 1770, p. 97. Chiefly in answer to Fontaine, who had attacked him, and who had claimed the invention of the test of integrability of an expression containing several variable quantities. Lagrange observes, that he might very possibly have rediscovered it, but that it was published by Nicolas Bernoulli in 1720; by Fontaine, not till 1738. 29. *On arithmetical theorems*, p. 123, relating to the decomposition of a number into squares. 30. *On the resolution of equations*, p. 134. 31. *On a theorem respecting prime numbers*, 1771, p. 125. A demonstration of the property of prime numbers discovered by Mr Wilson, and published by Waring; and of some other theorems of Waring. 32. *On equa-*

Lagrange. *tions*, p. 138. In continuation. 33. *On a new mode of differentiation and integration*, 1772, p. 185. The novelty consists in considering the characteristic of a fluxion as a quantity multiplying the letter to which it is prefixed, and inferring by induction that the result of the combinations obtained will in general remain unaltered by the supposition. The grounds of this method have been of late more fully explained by Arbogast and others. The results are here applied to interpolations, and to differences of various orders. 34. *On the form of imaginary roots*, p. 222. In general reducible to $A + \sqrt{-1}B$. 35. *On astronomical refractions*, p. 259; without any practical applications. 36. *On equations of partial differences*, p. 353; especially on finding multipliers to make them integrable. 37. *On undisturbed rotation*, 1773, p. 85. A more direct method of investigation than that of Euler or Dalembert; but without any new results. 38. *On the attraction of elliptic spheroids*, p. 121. The author observes, that Maclaurin's prize essay is a masterpiece of geometry, comparable to the best works of Archimedes, though Dalembert had once doubted of the accuracy of some of his propositions. Thomas Simpson's was the first analytical solution of the problem, but it was indirect, and depending on series only. In this paper the method of demonstration only is varied. Legendre and Laplace subsequently continued the inquiry. " But Mr Ivory," says Delambre, " has lately shown us, that a very simple consideration may in some cases supersede a multitude of calculations, and even afford us theorems to which the most prolix computations could scarcely have conducted us." 39. *On triangular pyramids*, p. 149. An analytical determination of the content, and of the figures that may be inscribed in the pyramids, when their six sides are given. 40. *Arithmetical researches*, p. 265; on the integral roots of equations of the second degree. 41. *On particular integrals*, 1774, p. 197. Laplace had already pointed out the occasional occurrence of integrals, not included in the general and direct expression obtained by the usual modes of integration. Such values are here deduced from the variation of the quantities originally considered as constant, which often affords us an equation of a different form, and leads to values not comprehended in the regular expression of the integral. 42. *On the motions of the nodes of the planetary orbits*, p. 276. Euler, Lalande, and Bailly had found some expressions for the temporary change of position of the nodes; the equations are here integrated, and the total changes determined. 43. *On recurring series varying in two ways, or on partial finite differences*, 1775, p. 183. With an application to the theory of chances, upon Laplace's principles. 44. *On spheroids*, p. 273. A demonstration of Maclaurin's theorem (*Fluxions*, Art. 653) concerning the attraction of a compressed spheroid or an amygdaloid; derived from the formulæ contained in the former papers. 45. *Arithmetical researches continued*, p. 323. Demonstrating some theorems of Fermat with which Euler had not succeeded: yet leaving others still unattempted. 46. *On the mean motions of the planets*, 1776, p. 199. Showing that all their changes are periodical. Laplace had detected an error in the author's reasoning when he attributed secular equations to the motions of Jupiter and Saturn, the expressions, containing the terms in question, being compensated by others which he had neglected. 47. *Cases of spherical trigonometry solved by series*, p. 214. Without any apparent advantage. 48. *On integration by continued fractions*, p. 236. Gives an example of the binomial theorem converted into a continued fraction, which, however, exhibits no particular elegance nor simplicity. 49. *On the number of imaginary roots of equations*, 1777, p. 111. Harriot was the father of the doctrine of equations. Newton made great improvements in it, but his rule remains imperfect with regard to the higher equations, even with the additions of Maclaurin and Campbell. In the present paper the theorem of Waring is demonstrated, without any material attempt to extend it. 50. *On the Diophantine analysis*, p. 140. It is remarked that Fermat left all his propositions undemonstrated, except this theorem, that the sum of two biquadrate numbers can never be a square. 51. *On escapements*, p. 173. An investigation of the best forms of pallets for the dead beat and the recoiling scapements. 52. *On determining the orbits of comets by three observations*, 1778, p. 111, 124. The first part of this memoir is historical and critical, and the author allows due credit to the ingenuity of Newton's method: his own does not appear to have been of any practical utility. 53. *On the theory of telescopes*, p. 162. Comparing the general theorems of Cotes and Euler, and applying the method of recurring series to their demonstration; with a rule for determining the magnitude of the field. 54. *On the expression of the time in a conic section*, p. 181. After Lambert, who determines it from the chord of the arc described, the sum of the revolving radii, and the great axis: the theorem is here analytically demonstrated. 55. *On particular integrals*, 1779, p. 121. Examples from some mechanical curves. 56. *On geographical projections for maps*, p. 161, 186. The methods here proposed for the construction of maps have been found too intricate for adoption. 57. *On the theory of the libration of the moon*, 1780, p. 203. In the prize essay on the moon's libration, the author had made the first application of the method of variations: the investigation is here continued, and it is observed that the moon cannot be of homogeneous matter, nor its form such as would afford equilibrium to a fluid covering it, since the effects of the ellipticity, so determined, would be much less perceptible than they are. 58. *Report on a quadrature of the circle. Hist. Ac. Berl.* 1781, p. 17. This paper only requires to be noticed as a specimen of the author's condescension. 59. *Theory of the motion of fluids, Mém.* p. 151. An application of Dalembert's principles to the phenomena of running fluids, and to the motion of waves; but founded on an arbitrary assumption with respect to the depth affected by the waves. 60. *On the secular variations of the elements of the planets*, p. 199. The theory of perturbations is here examined by two methods, either comprehending the general form of the orbit, or regarding the local effects only. 61. *Report on a*

 mode of finding the form of the earth, Hist. 1732, p. 35. A proposal of no value whatever. 62. *On the secular variations of the planets, Mém.* p. 169. A continuation of the former memoir, with all the details of the application, and a determination of the change of the place of the ecliptic, together with a demonstration of the permanency of the general arrangement of the system, depending on the exemption of the mean distances from all variations not periodical, while the other elements are liable to greater alterations. 63. *On the periodical variations of the planetary motions*, 1783, p. 161. A sequel to the memoirs on the secular variations. 64. *Additions respecting the secular variations*, p. 191. Completing the examination, and extending it to the case of Jupiter and Saturn, which had before been investigated by Laplace. 65. *On the correction of the errors of astronomical approximations*, p. 224. The errors here considered arise from the employment of the powers of the arcs described in the equations concerned, these arcs increasing without limit: they may be avoided by means of approximations founded on the supposition of the variation of the elements. Laplace had before employed a method still more refined. 66. *On a particular mode of approximation*, p. 279. Resembling that which Briggs employed for making logarithms. 67. *On a new property of the centre of gravity*, p. 290. Relating to the mutual distances of the bodies. 68. *A direct and general determination of the motion of a comet*, p. 296. In this third memoir the problem is reduced to equations of the 8th or 7th degree. 69. *Theory of the periodical variations of the planetary motions*, 1784, p. 187. Continuation of the memoir of the preceding year, containing the independent variations of the eccentricities and inclinations, for the six principal planets; with a numerical application of the formulæ demonstrated in the first part. 70. *On the integration of equations of linear partial differences*, 1785, p. 174. Entering into further details of the method laid down in a former paper, which is here applied to the problem of trajectories, a problem once proposed by Leibnitz as a trial of strength to Newton, who was not fully aware of the nature of the difficulty intended to be combated: it was, however, solved in England by Taylor, though indirectly. Nicolas Bernoulli and Hermann gave a more complete solution, and Euler added still more to the generality of the investigation. The author observes that the problem is a mere curiosity; there is, however, one case in which a trajectory of the kind here considered is actually applicable to a natural phenomenon of common occurrence, which is that of a wave diverging from a point in a gradually shelving shore; for the figure or direction of the collateral parts of such a wave may be shown to be the orthogonal trajectory cutting an infinite number of cycloids beginning at the given point. 71. *On the motion of the aphelia of the planets*, 1786, i. A geometrical investigation, in the manner of Newton, intended as an appendix to the *Principia*. 72. *On the theory of sound and waves*. This paper is also intended to complete the demonstrations contained in the same work. The volume, in which both these interesting memoirs appear, seems to have been published out of the regular order, from some circumstances connected with the death of Frederic; and it is wanting in many of the British libraries. 73. *Note accompanying a memoir of Duval le Roi*, 1786–7, p. 253. On the secular equations of the Georgian planet. 74. *On a question relating to annuities*, 1792–3, p. 235. The case of an annuity supposed to commence after a death, and to cease at a given age. 75. *Additions to former memoirs*, p. 247. On recurring series (n. 45); on elliptic spheroids (n. 38); on interpolations, in Mouton's manner, comprehending the inequality of the distances of the observations; on the secular equation of the moon (n. 64). After Laplace's great discovery of the cause of the secular acceleration, Lagrange found that it might have been easily deduced from his own calculations, almost in the same form, if he had not accidentally neglected the application, from having assured himself, in 1783, that the results of a similar computation were nearly insensible in the case of Jupiter and Saturn. It was in 1787 that the discovery of Laplace was announced. The acceleration here computed is 10",5 for the first century after 1800. Mayer found it 9" from a comparison of observations. 76. *On a general law of optics*, 1803, Math. p. 3. A demonstration of the foundation of the method long used by English opticians for determining the magnifying powers of telescopes of all kinds, which form an image of the object-glass beyond the eye-glass, by measuring the diameter of that image. The author hazards, in this paper, the very singular assertion, that the illumination of the object must be the same in all telescopes whatever, notwithstanding the common opinion, that it depends on the magnitude of the object-glass; and his reasoning would be correct, if the pupil of the eye were always less than the image of the object-glass in question; since, as he observes, the density of the light in this image is always inversely as the magnifying power: but he forgets to consider that the illumination on the retina, when the whole pencil is taken in, is in the joint ratio of the density and the extent; a consideration which justifies the common opinion on this subject, and shows that a most profound mathematician may be grievously mistaken in his conclusions, if he proceeds to calculate upon erroneous grounds. It deserves, however, to be remembered, that the brightness of any given angular portion of a magnified image must always be somewhat less than that of an equal portion of the object seen by the naked eye: because it can be no greater if the pencil fills the pupil, and will be less in proportion as the pencil is smaller than the pupil, besides the unavoidable loss of light at the refracting surfaces.

77. The later works of Lagrange have principally been published at Paris, and most of them in the various Collections of the Academy. The earliest of these are the prize memoirs, and first the essay *On the libration of the moon*, which obtained the prize in 1764. *Ac. Par.* Prix. IX. 1772. It is in this memoir that the method of variations was first practically applied to a mechanical problem. 78. *On the inequalities of the satellites of Jupiter*, in 1776. Including the consideration of their mutual perturbations, and consequently a case of the problem of

six bodies. The author never resumed the subject, but its investigation was completed by Laplace. 79. *A new method of solving the problem of three bodies*, in 1772. 80. *On the secular equation of the moon*, in 1774. *M. Sav. Etr.* VII. for 1773. An unsuccessful attempt, with conjectures respecting the existence of a resisting medium, and even doubts of the accuracy of the foundation of Halley's discovery. 81. A prize memoir, *On the perturbation of comets passing near planets. M. Sav. Etr.* X. Par. 1785, p. 65. Finding the path directly, without regard to the conic sections, and employing three different modes of computation for the different parts of the orbit. 82. *On forming tables by observations only*, *Mém. Ac. Par.* 1772, i. p. 518. The method of recurring series is principally employed, and the author observes that the problem is more useful than difficult, giving an experimental example in the equation of time, for which he obtains from the results of the tables an expression very near the truth. Delambre remarks that this is only a continuance of the system adopted by Ptolemy and the other ancient astronomers, showing what we might have done in a circuitous manner by pure mathematics, if Newton and the laws of gravity had not existed; and he thinks the paper only valuable as a specimen of Lagrange's talent for overcoming difficulties, which he might more easily have avoided. 83. *On the nodes and inclinations of the planetary orbits*, 1774, p. 97. With details of the calculations for all the planets. 84. *On the variation of the elements of the planets. Mém. Math. Inst.* 1808, p. 1. The object of this paper is to show, as Poisson had done before, that all the changes of the system are periodical. The method is more general, but less simple than that of Laplace, who first discovered the principle by induction. The lunar acceleration is given as an example. Mr Poisson has extended his calculations to quantities of the second order, which do not enter into Lagrange's investigations. 85. *On the variation of independent quantities in general in mechanical problems*, p. 257. The author observes that many of the modern improvements of mathematics depend on the doing away the distinction between constant and variable quantities, which was so valuable when it was first enforced by Descartes. 86. *A second memoir on the variation of independent quantities*, 1809, p. 343. Simplifying the general application of the doctrine.

87. *Lectures on arithmetic and algebra. Séances des Ecoles Normales*, year III. 1794-5. The first lecture relates to the elements of arithmetic, the second to the lower orders of equations, and the third to the higher. All these lectures, under the name of conversations, were taken down in short-hand by some of the students, and afterwards corrected by the professors.

88. *An essay on political arithmetic.* Roederer, *Collection de divers Ouvrages.* Paris, an. IV. 1795-6.

89. In the *Journal de l'Ecole Polytechnique*, we find an *Essay on numerical analysis, and on the transformation of fractions*, Vol. II. 1798, p. 95. It contains the elementary theory of continued fractions, and the mode of reducing them. 90. *On the principle of virtual velocities*, p. 115. Chiefly relating to pulleys. 91. *On the object of the theory of analytical functions*, VI. 1800, p. 232. A detailed explanation of the grounds of the theory laid down in the separate publication on this subject. 92. *Analysis of spherical triangles*, p. 270. Giving all their essential properties in a concise form. 93. *Lectures on the calculus of functions*, XII. 1804. Published also separately in 8vo. A commentary on the theory of functions, and a supplement to it, contained in twenty lectures. 94. *Two more lectures*, XIV. 1808; at the end, chiefly relating to the method of variations. 95. *On a difficulty respecting the attraction of spheroids*, VIII. xv. Remarks which may serve as a commentary on a passage of the *Mécanique Céleste*.

96. *On the origin of comets. Connoissance des Tems*, 1814. 97. *On the calculation of eclipses, as affected by parallax*, 1817. From the *Berlin Almanack* for 1782. This memoir, as Delambre observes, is singularly attractive to a person previously unacquainted with the methods which are employed; but though the formulæ first introduced are direct and rigorously accurate, the whole investigation ends in an approximation which wants both these properties.

98. The most important of all the works of Lagrange are those which have appeared in separate volumes; and among these we may reckon his *Additions à l'Algèbre d'Euler*, 8. Lyons, 1774, Vol. II. German, 1796. English, 1797. They relate chiefly to continued fractions, and to indeterminate problems, and constitute the most valuable part of the whole work, which, in its abridged form at least, is far inferior to Maclaurin's *Algebra*. 99. *Mécanique analytique*, 4. Par. 1788, 2d edit. Vol. I. 1811, Vol. II. by Prony, Lacroix, and Binet, 1815. This work exhibits a uniform and elegant system of mechanical problems, deduced from the simple principle of virtual velocities, which was well known to former authors, but never so extensively applied. It has been remarked, that many parts of it may be read with advantage, even by those who are not competent to enter into any of the computations, exhibiting such a history of the progress of the science, as could only have been sketched by a master. The new edition, begun at the age of 75, comprehends all the improvements contained in the author's later memoirs on various subjects. 100. *Théorie des fonctions analytiques*, 4. Par. 1797, 1813. The abstract theory of analytical functions has been very fashionable among modern mathematicians; but the improvements which it contains are chiefly of a metaphysical nature, if they can with propriety be called improvements. The notation is less simple than that which is in common use, and has been abandoned by the author in some republications of the works in which he had at first employed it. The calculations, too, are often more intricate than others which afford the same conclusions. 101. *Résolution des équations numeriques*, 4. Par. 1798, 1808. The refined and abstruse speculations, contained in this volume, are more calculated to promote the advancement of the abstract science of quantity, than to be applied, as the title would seem to denote, to the purposes of numerical computation. The methods investigated are in general laborious and complicated, though instructive.

Lagrange.

and capable of extensive application; and for equations, of which all the roots are real, the author himself recommends Mr Budan's method, as preferable to his own. The second edition contains a number of very interesting notes, which are full of ingenuity and novelty.

The author of so immense a series of laborious investigations must certainly have been a most extraordinary man. He had acquired the character of an illustrious mathematician almost in his boyish years; and he continued to apply the force of his powerful mind, for more than half a century, to the almost uninterrupted pursuit of his favourite sciences. It seems, however, that his earliest were also his greatest successes; and all that followed was as little as could well be expected, from a continued employment of the means which he possessed at the beginning; for, in fact, the whole taken together appears to bear a stronger charac[ter] of great industry, than of great sagacity or talen[t].

" It was formerly usua[l]," says Delambre, " for mathematicians to inqu[ire i]n every investigation, for some general considerations, which might be capable of simplifying it, or of reducing it to a problem already resolved, and to endeavour by these means either to abridge the calculation, or sometimes to supersede it altogether. But since the discovery of the infinitesimal calculus, the facility and universality of this method, which often renders the possession of ANY TALENT IN THE CALCULATOR WHOLLY UNNECESSARY, has made it more usual for mathematicians to direct their chief attention to the perfection of this all powerful instrument. But at the present day, when researches of this kind appear to be completely exhausted by the labours of Euler, Lagrange, and their industrious contemporaries, it might perhaps be more advisable to return to the ancient method, and to follow the example of" Newton, surely, and of " Daniel Bernoulli, who, as Condorcet observes, was entitled to the praise of moderation in the introduction of his calculations. Lagrange was in the habit of employing his sublime talents in a different manner: he liked to make every thing dependent on his analysis, though, in some instances, he united both methods in the highest degree, as his invention of the calculus of variations bears witness. His reducing the theory of sound to that of the vibration of chords, is a specimen of a very ingenious simplification; as well as his mode of computing the planetary motions by the variation of the elements of their orbits, which is also applicable to all other cases of the operation of small disturbing forces. But it must be confessed, on the other hand, that he has sometimes created difficulties where none existed, by applying his profound and ingenious methods to the solution of elementary problems, which may be obtained from a construction of the simplest kind; and the powerful agents which he employs, on many trifling occasions, remind us only of the man in the fable, who came to borrow the club of Hercules, and the thunder of Jupiter, for the purpose of destroying a flea;" or of the modern mathematician, who, without any fable, or any figure of rhetoric, proposed to adjust a standard measure, by placing it at a distance, and viewing it with a good telescope. The habit of relying too confidently on calculation, and too little on common sense, will perhaps account for the mistakes of Lagrange, which have been already noticed, respecting the forms of columns, and the illumination of optical instruments: nor are they the only instances of the kind which may be produced from the modern history of the sciences. It seems, indeed, as if mathematical learning were the *euthanasia* of physical talent; and, unless Great Britain can succeed in stemming the torrent, and in checking the useless accumulation of weighty materials, the fabric of science will sink in a few ages under its own insupportable bulk. A splendid example has already been displayed by the author of the article ATTRACTION in this *Supplement*, and to do justice to our neighbours, it must be allowed, that they have received the boon with due gratitude, and acknowledged it by merited applause: " All the analytical difficulties of the problem," say Legendre and Delambre (*M. Inst.* 1812), " vanish at once before this method; and a theory, which before required the most abstruse analysis, may now be explained, in its whole extent, by considerations perfectly elementary." It is indeed only when a subject is so simplified, that the investigation can be considered as complete, since we are never so sure that we understand the process of nature, as when we can trace at once in our minds all the steps by which that process is conducted. It is not without some reason that a similar disposition, to revel in the luxury of mathematical sports, has been sometimes objected to Laplace, a man of equal analytical acquirements with Lagrange, but possessed apparently of greater sagacity, and certainly more successful in his application of mathematics to physical researches, although he, also, seems, on some occasions, to have suffered his habits of abstract reasoning to lead away his attention from the true conditions of the problem; particularly in his first supplement respecting capillary attraction, which concludes with an equation so erroneous, that he has been obliged to abandon it in silence. (See the article COHESION.) Another instance of ill applied computation has been noticed in the article CHROMATICS; when Laplace attempted to deduce the laws of extraordinary refraction from the principle of the minimum of action, he seems to have forgotten that the demonstration of that principle, in his own great work, rests *expressly* on a condition which is here wanting, that " the forces concerned must be functions of the distances," and of course independent of the directions. These imperfections, however, would not deserve to be noticed as materially affecting the general merits either of Lagrange or of Laplace, but they may be considered as accidents, which ought to warn us, against relying too implicitly on authority, however high, when it appears to militate against clear simple reasoning, and sound common sense.

Delambre, *Mém. Inst.* 1812, ii.—*Journal de l'Empire*, 28, Apr. 1813.—Virez et Potel *Précis Historique*, 4. Paris, 1813.—Cossali *Elogio*, 8. Padua, 1813. —Maurice in *Biographie Universelle*, XXIII. 8 Paris, 1819. (A. M.)

Lagrange || Lalande.

LALANDE (JOSEPH JEROME LE FRANÇAIS [de]), a most zealous and accomplished astronomer, born at Bourg en Bresse, 11th July 1732, was the son of

Lalande.

Peter Lefrançais, and Marianne Mouchinet, his wife.

His parents were in easy circumstances, and his education being somewhat too indulgent, the natural quickness and impetuosity of his temper was too little restrained. His earliest taste, like that of most other children, seems to have been for romantic tales, and he was fond of making little stories with the materials that he possessed, but their subjects were chiefly religious. He was in the habit of living much with the Jesuits, and he imbibed from them a predilection for the pulpit; at the age of ten he used to amuse himself with making sermons, and preaching them to a select congregation. The comet of 1744, however, with its long tail, took more forcible possession of his imagination, and he watched it with the most unremitting attention. Having been sent to Lyons, to continue his studies under the Jesuits there, he acquired a taste for poetry and eloquence, and was then inclined to devote himself to literature and to the bar; but an eclipse of the sun recalled his attention to astronomy. His parents wished him to follow the profession of a magistrate, and sent him to Paris with that view; but he accidentally lodged in a hotel where Delisle had established an observatory, and this circumstance led him to become acquainted with that professor, and to attend his lectures. These lectures were by no means popular; and the want of a more numerous audience made it easy for the professor to accommodate his instructions to the fixed attention and rapid progress of his new pupil, who became singularly attached to his master, and to all the methods which he employed. Lalande attended, however, at the same time, the physico-mathematical lectures of Lemonnier, who was more in credit as a teacher, and who also took great pains for his improvement.

In the meantime he had completed his legal studies, and at the age of eighteen he was called to the bar as an advocate. His family was anxious for his return to Bourg; but just at that time Lemonnier obtained leave to nominate him as a substitute for himself on an astronomical mission to Berlin, where he was to make observations on the lunar parallax, corresponding with those which Lacaille was sent to the Cape to obtain. He was favourably received by Maupertuis, who introduced him to Frederic and his court; and was made a Member of the Academy of Sciences at Berlin, when he was about nineteen.

He remained a year in that city, observing at night, and passing his mornings in the study of the integral calculus, under Euler's direction; and his evenings in the society of Voltaire, Maupertuis, D'Argens, and other men of talents. It was not likely that the intercourse with such persons should confirm the principles which he had imbibed from the Jesuits; his moral conduct however, does not appear to have been influenced by his change of sentiments. After his return to Bourg, he pleaded a few causes to oblige his friends; but the success of his operations at Berlin obtained him speedily a place in the Academy of Sciences at Paris; for, in 1753, before he was twenty-one, he was chosen to fill up a vacancy in the department of astronomy, which had been open for some years. He soon after offended his friend Lemonnier, by rejecting too harshly an unfounded objection of that astronomer to his method of computing the effect of the earth's ellipticity on the lunar parallax, which differed from Euler's formula. Lacaille, who drew up the report of a committee appointed on the occasion, decided in Lalande's favour; but Lemonnier remained dissatisfied, and would not see him for twenty years. He had some similar discussions, at a later period, with Duséjour, who was a little too severe in criticizing some of his approximations, as if they had been intended to be rigidly accurate; but their personal friendship remained unaltered.

For more than fifty years he continued to be a constant and voluminous contributor to the *Memoirs* of the Parisian Academy, as well as to other scientific collections. His investigations were always judiciously directed to the advancement of astronomy; but they can scarcely ever be said to have exhibited any marked features of talent, or of address, beyond what might be expected from the industry of a man of good ordinary abilities, confining himself almost entirely to one subject. He was always anxious to call the public attention to astronomy as a science, and to himself as an individual. Thus, on occasion of the transits of Venus in 1761 and 1769, he addressed a circular letter to most of the governments of Europe, on the importance of obtaining a multiplicity of collateral observations, and he received in reply several invitations, from sovereigns whose countries were more favourably situated for the purpose than France, to come and make the observations in person. He thought it, however, unnecessary to leave Paris on the occasion; he contented himself with being the first to announce to the public the result of the most satisfactory comparisons; and his countrymen seemed to give him almost the whole credit of every thing that had been done by others, in conformity with his suggestions. He was much mortified, however, in not receiving from Father Hell an account of the observations made at Wardhus: and he was afterwards greatly inclined to dispute their accuracy, because Hell made the parallax smaller than he did by $\frac{1}{4}$ of a second: while the mean of both results, which is 8, 6″, agrees extremely well with the most modern computations: but, in the end, he did justice to the importance of Hell's observations.

He was constantly in the habit of passing a few months every year with his family in the country, and he occasionally amused himself, in the course of these visits, with mineralogical excursions, and with chemical studies. He delivered, about the year 1758, an oration, before a public assembly at Lyons, on the advantage of monarchy above every other form of government; he even adhered to a similar opinion, and expressed it openly, in times when nothing but his celebrity, as a man devoted exclusively to science, could have made it safe for him to declare it.

After having published the Astronomical Tables of Halley, he felt the necessity of a new collection, and determined to begin with those of Mercury, which he found the most imperfect. He pursued, for this

purpose, a regular course of observations at the Palais Royal, where he used to go before sunrise, in the winter mornings, to see the planet in the twilight. Having occasion to refer to the observations recorded by Ptolemy, he found it necessary to refresh his acquaintance with the Greek language, which he had in some measure neglected. But, with all his labour and diligence, his tables of Mercury exhibited, in 1786, an error of 40 minutes in the time of a transit: the circumstance mortified him extremely; but it led to a revision of the tables, and he afterwards succeeded in making them much more perfect. It must be recollected, that, in the time of Hevelius, a transit was anxiously expected for four whole days before it occurred.

He next undertook to improve the tables of Mars and Venus: his tables of these planets were, on the whole, less accurate than those of Mercury, though more exempt from great occasional errors. He had computed their perturbations in the *Memoirs* of the Academy; but he never thought it worth while to compare his formulas with observation. The irregularities of Jupiter and Saturn were much more discouraging; he was obliged to confine himself, in discussing them, to the most modern observations; and he did not appear sufficiently to appreciate the empirical equations of Lambert, though they greatly diminished the errors of Halley's tables.

When Maraldi had given up the management of the *Connaissance des Tems*, Lalande and Pingré were candidates for the appointment. Lalande succeeded in obtaining it; but he had the modesty to confess that the work would have been more accurately performed by Pingré, if his connexion with the church had not, according to the rules of the Academy, incapacitated him for the situation. He made the work, however, much more popular, as a miscellaneous publication, than Pingré was likely to have done; and he was less prejudiced than Pingré in the choice of his tables. He remained editor of the work from 1760 to 1775; it was conducted by Jeaurat from 1776 to 1787, and from 1788 to 1793 by Méchain: Lalande then undertook it once more; Méchain being engaged in some measurements with Delambre, the Academy having been abolished, and its members dispersed.

Lalande had been disposed to call in question the assertion of Newton and of Voltaire, that no comet could possibly come into contact with the earth; and he had proved that the effect of perturbations at least rendered their reasonings somewhat inconclusive. A short memoir on the subject, which was to have been read at a public sitting of the Academy, was accidentally omitted, as not very important, from the pressure of other business. This circumstance alarmed the sensibility of the public of Paris, who fancied that Lalande had foretold some dreadful catastrophe, which the Government was afraid to announce; and when the memoir was published, they insisted that its contents had been modified, to lessen the alarm. Duséjour made some objections to the author's reasoning: but the whole affair was soon forgotten.

A memoir on the length of the year was honoured with a prise by the Academy at Copenhagen. Delambre, however, thinks the determination not so good as the earlier one of Lacaille, though much better than Mayer's, which was more commonly adopted. Lalande took great pains also with the subject of the sun's rotation, employing in his computations of the places of the spots an easy approximation, instead of Duséjour's more laborious methods; but being careful to compare with each other the most distant observations of the same spot. From the existence of this rotation he thought it reasonable to infer that the sun had also most probably a progressive motion, which would naturally be produced by any single impulse capable of occasioning a rotation. He had some discussions with Dr Maskelyne, respecting the mode of computing the equation of time, in which Maskelyne appears to have had the advantage.

In the year 1762, Delisle resigned in his favour the Professorship of Astronomy in the College de France, which he kept for nearly 46 years. He allowed the most attentive of his pupils to board with him at a cheap rate, doing his utmost on all occasions to promote their success in their sudies and in life. Thus he brought forwards Méchain and Dagelet, and afterwards his own nephew, who completed, with so much diligence and accuracy, the *Description of the Heavens*, which he had himself projected, and which had been begun by Dagelet before his unfortunate expedition. He was made a Fellow of the Royal Society of London in 1763.

His health was generally good, though his constitution was delicate. He had an attack of jaundice in 1767, which was attributed to intense application; but he completely recovered from its effects by an attention to diet, and by the use of horse exercise. He then intended to leave all his property to the Academy; but he afterwards gave up his family estates to his relations, and lived on his appointments only, refraining from all kinds of luxuries, in order to be the more able to do acts of liberality to his friends, whom he always sought to oblige in the most delicate manner, and often without making his services known. He had a pension from Russia in the time of the Empress Catherine; it was suspended by Paul, but restored in 1805 by Alexander.

He was not particularly successful as an observer, but used to refer to the works of his contemporaries, Bradley and Lacaille, though not exactly according to the expression of one of his biographers, "as Ptolemy had done to those of Hipparchus;" for Hipparchus must have been dead two centuries before Ptolemy was born. On the occasion of the disappearance of the ring of Saturn in 1774, he went to Béziers, in order to profit by the superior serenity of the air there, the climate of that country being supposed to be the best in France; but his observations were less valuable than others made at Paris and in London.

In the year 1798, he undertook an astronomical expedition to Gotha. He had once meditated an aerostatical voyage there; but his companion took care that their dangers should terminate in the Bois de Boulogne. He was received with much interest

Lalande.

at Gotha by an assembly of astronomers, that was collected from different parts of Germany. The object of the congress was perhaps not unmixed with personal vanity; but it had no political design to promote, unless the general adoption of the new French measures could be considered as a political object. Lalande was by no means a revolutionist: he was sufficiently free from any prejudices of education; but he openly condemned the political opinions of the day; and, in 1792, he even exposed himself to great personal danger, in order to save the life of Dupont de Nemour, after the 10th August; and he was equally useful to some of the clergy, whom he concealed in the buildings of the Observatory at the College Mazarin, making them pass for astronomers. He had also the courage to publish accounts of Lavoisier and Bailly a short time after their deaths.

The attentions of the German astronomers gave him sincere pleasure. He was at all times extremely sensible to compliments, and even to flattery, though very regardless of satire. He used to call himself a sponge for praise, and an oil-cloth for censure. He professedly believed himself endowed with all the virtues, modesty not excepted. He was so fond of notoriety, that he once undertook to exhibit the variations of the light of Algol to the public of Paris on the Pont Neuf; but the police interfered, thinking it right to prevent a disorderly assemblage.

Though Lalande can only be classed in the second rank as an inventive astronomer, or a mathematician, he certainly stands in the first as a professor and a popular writer. His methods of calculation have in most instances been already superseded by others more convenient or more exact; those which related to particular phenomena for want of sufficient precision, and those which were more general for want of being readily applicable, without continual repetition, to a sufficient number of concurring observations. It has been observed, that he may perhaps have been often too zealous in the pursuit of his favourite objects; but that, if he had possessed more circumspection, and less vivacity of character, he would have been more exempt from criticism, but he would have rendered less important services to science and to mankind.

His last illness was of a consumptive nature, and he seems to have accelerated its termination by attempting too much to harden himself. He died 4th April 1807, nearly 75 years old, and in the perfect possession of his faculties. His last words, when he dismissed his attendants to rest, were, "I have need of nothing more," and in a few minutes he was dead. Had he survived a few hours, he would have received a letter from Dr Olbers, announcing the discovery of a new planet; for which that distinguished astronomer afterwards received the fourth prize medal upon the institution founded by Lalande in 1802, for the most important astronomical discovery made in the course of the year.

Of his voluminous and diversified publications a simple enumeration of the subjects will perhaps be thought too long for perusal, though not improper for insertion in a work, which ought to comprehend a complete literary history or bibliography of the sciences.

Lalande.

1. We find, in the *Memoirs of the Parisian Academy of Sciences for* 1751, an account of his *Observations at Berlin;* which also appears in the *Memoirs of Berlin* for 1749; and a Latin translation in the *Acta Eruditorum* for August 1752. 2, 3. 1752–53. *An Essay on the Lunar Parallax.* 4. 1754. *A transit of Mercury.* 5. *Elements of Mars.* 6. 1755. *Longitude of Berlin.* 7. *Lunar Eclipse.* 8. 1756. *Transit of Mercury.* 9. *Lunar parallax* continued. 10. 1757. *Observations at the Luxembourg.* 11. *Transit of Venus.* 12. *Secular equations and mean motions.* 13. *A gnomenical problem.* 14. *Meridian altitudes.* 15. 1758. *Perturbations of Mars by Jupiter.* 16. *Motions of the planetary nodes.* 17. *Change of latitudes of the stars.* 18. 1759. *Comet of 1682 and* 1759. 19. 1760. *Sun's diameter.* 20. *Perturbation of Venus by the earth.* 21. *Eclipse of* 1760. 22. 1761. *Solar parallax.* 23. *Interpolation.* 24. *Transit of Venus observed.* 25. *Solar parallax.* 26. *Transit computed.* 27. *Observed at Tobolsk.* 28. *In Denmark.* 29. *Compasses, and the variation.* 30. *Perturbation of Mars by the earth.* 31. *Planetary nodes.* 32. 1762. *Equation of time.* 33. *Obliquity of the ecliptic.* 34. *Horary motion in transits.* 35. *Nodes of Jupiter's satellites.* 36. *Diameter of Venus.* 37. *Comet of* 1762. 38. 1763. *Eclipses of Jupiter's satellites.* 39. *Solar eclipses for a spheroid.* 40. *Triangles, rectilinear and spherical.* 41. 1764. *Transit of* 1769. 42. *Lunar libration.* 43. 1765. *Motion of Saturn.* 44. *Eclipses of Jupiter's satellites.* 45. *The third satellite.* 46, 47. 1766. *Theory of Mercury.* 50. 1768. *Opposition of Jupiter.* 51. *Transit of* 1769. 52. *Orbit of Saturn.* 53. 1769. *Lunar observations.* 54. *Comet of* 1769. 55. *Transit of Venus.* 56. *A solar eclipse.* 57. *Transit of Venus.* 58, 59, 60. *Comparisons of observations.* 61. 1779. *Solar parallax.* 62. *Sun's diameter.* 63. *Appearances in the transit.* 64. *Chappe's observation.* 65. 1771. *Theory of Mercury.* 66. *Astronomical observations.* 67. *Solar parallax.* 68. 1772. *Transit of Venus.* 69. *Tides.* 70. 1773. *Comets.* 71. *Saturn's ring.* 72. 1774. *An opposition of Saturn.* 73. *Saturn's ring.* 74. *Disappearance of the ring, at Begiers.* 75. 1775. *Opposition of Mars.* 76. *Elements of Mars.* 77. *Same latitudes and longitudes.* 78. *Opposition of Jupiter and Saturn.* 79. *An eclipse of Saturn.* 80. 1776. *Spots and rotation of the sun.* 81. 1777. *Observations at Paris and Madrid.* 82. *An observation of Mercury.* 83. *Longitude of Padua.* 84. *The solar spots, continued.* 85. 1779. *Third satellite of Jupiter.* 86. *Theory of Venus.* 87. *Herschel.* 88. 1780. *Obliquity of the ecliptic.* 89. *Precession of the equinoxes* 90. *Fourth satellite of Jupiter.* 91. 1782. *Duration of the year.* 92. *A transit of Mercury.* 93. 1783. *An eclipse of the sun.* 94. *Inclination of the orbits.* 95. 1784. *Elements of Jupiter.* 96. *Ellipticity of the earth.* 97. 1785. *Motion of Venus.* 98. 1786. *Secular equations of the sun and moon.* 99. *Mass of Venus.* 100. *Equation of Mars.* 101. *Mars in quadrature.* 102. *Orbit of Saturn.* 103. *Theory of*

Lalande. *Mercury, fifth memoir.* 104. *Satellites of Jupiter.* 105. *Fifth of Saturn.* 106. 1787. *Ferrche measurement.* 107. *Herschel's.* 108. *Jupiter's third satellite.* 109. *Conjunction of Venus.* 110. *Motion of Saturn.* 111. *Inclination of Saturn.* 112. *Answer to Lemonnier, on lunar observations.* 113. *Solar eclipses of* 1787. 114. *Eclipse of* 1666. 115. *Caspian sea.* 116. 1787. *Eclipse of* 1765. 117. 1788. *Eclipses applied to longitudes.* 118. *Conjunction of Venus.* 119. *Lunar parallax, fourth memoir.* 120. *Moon's diameter.* 121. *Jupiter's fourth satellite* 122. *Satellites of Saturn.* 123. *Light of Algol.* 124. *Height of the Seine.* 125. 1789. *Epacts.* 126. *Observations of* 8000 *stars, first part.* 127. *Motion of Venus.* 128. *Astronomical observations.* 129. *Observation of Mercury.* 130. *Tides.* 131. *Catalogue of stars, second part.* 132. 1790. *Disappearance of Saturn's ring.* 133. *Interior of Africa.* 134. *Mém. Inst.* I. 1798. *Orbit of Mercury.* 135. II. 1797. *Occultations of Aldebaran.* 136. *Solar eclipse of* 1706. 137. *Solar eclipse of* 1748. 138. V. 1803. *Zodiac at Strasburg.* 139. *Eclipses calculated.* 140. *Opposition of Mars.* 141, 142. *Motion of Venus.* 143. *Motion of Mercury.* 144. VI. 1806. *A transit of Mercury.*

145. The earliest of his separate publications appear to have been, two little volumes, intended for provincial circulation only, entitled *Etrennes Historiques*, 24. Par. 1755-6. 146. Another little article of his miscellaneous works was a *Discours qui a remporté le prix de l'Académie de Marseille*, en 1757. Mars. 1757. The subject was the spirit of justice, as tending to the glory and the stability of a government. 147. We have then *Three letters on platina.* *Jour. des Sav.* 1758. Jan. Jun. 1760. Feb. 148. *Letter on a new sun dial.* *Jour. Sav.* Jun. 1758. ii. 139. The lines being invisible when the sun does not shine.

149. *Tables astronomiques de Halley*, 2 v. 8. Paris, 1759. Containing several new tables, and an elaborate history of the comet of 1759, of which the author had computed the perturbations, according to the theory of Clairaut. 150. *Connaissance des tems*, 16 vols. 8vo. Par. 1760-1775. 12 vol. 1794-1807. This work contains, besides, the *Ephemeris*, an important selection of the most useful astronomical papers. On one occasion, for temporary reasons, these papers were published in a separate volume. 151. *Exposition du calcul astronomique.* 8. Paris, 1762. A companion to the almanac.

152. *Oraison funèbre de Maurice Comte de Saxe*, 8. Par. 1760. 153. *Art du Papetier*, f. Par. 1761. 154. *Parcheminier*, 1762. 155. *Cartonnier*, 1764. 156. *Chamoiseur*, 1764. 157. *Tanneur*, 1764. 158. *Mégissier*, 1765. 159. *Maroquinier*, 1766. 160 *Hongroyeur*, 1766. 161. *Corroyeur*, 1767.

163. *Letter on Delisle's calculations*, *Journ. Sav.* Apr. 1761. 164–5. In the 52d volume of the *Philosophical Transactions* for 1761 and 1762, we find several papers of Lalande; two *On the transit of Venus*; 166. one *On* Norwood's *measurement of the earth*; 167. An *Account of a comet*; and, 168. *An account of occultations of the fixed stars by the moon.* 169. In the *Transactions* for 1769, another paper on *the transit of Venus.*

170. *Discours sur la douceur*, 1763. This essay was intended as a sort of exercise for the author's own moral improvement; and he made it a rule to read it over and over every year, in order to assist him in commanding his temper. He may possibly have derived some little advantage from the practice, but he never acquired enough of self-command to refrain from wounding the feelings of another, by any pointed remark that might suddenly occur to him.

171. *Astronomie*, 2 v. 4. Paris, 1764. 3 v. 1771, 1792, Vol. IV. 1780, not reprinted. This compilation far excelled, in utility, all former works of the kind, and will always be considered as exhibiting the most perfect picture of the science, such as it existed from 1760 to 1790, with all the details of practice and computation. Lemonnier called it, with some truth, the great newspaper of astronomy. The *Treatise on the Tides*, which constitutes the fourth volume, is chiefly a collection of observations, not sufficient even for the basis of a complete theory: an abstract of it may be found in the *Mem. Acad.* Dijon, II. 1774. 172. *Figure du passage de Venus de* 1769, Paris, 1764. Together with an explanatory memoir. 173. *On the equation of time.* *Recueil pour les astronomes*, 1765.

174. He undertook the mathematical department of the *Journal des Savans*, from 1766. 175. *On the coins of Piedmont*, *Journ. Sav.* Dec. 1767. 176. *Voyage d'un François en Italie*, 8 vol. 12. A correct guide and faithful repertory for travellers, containing some scientific information, besides maps of the principal cities. 177. *Dissertation sur la cause de l'élévation des liqueurs dans les tubes capillaires*, 8 Par. 1770. 178. *A dictionary of astronomy*, in the *Encyclopédie d'Yverdun*, 56 v. 4. 1770–6. 179. *Abrégé d'astronomie*, 8. Par. 1773, 1795, translated into various languages. 180. *Notes* on the *Mondes* of Fontenelle, 24, Paris, often reprinted. 181. *Notes* on Bouguer's *Traité de Navigation.* 182. *Mémoire sur le passage de Venus*, 4. Par. 1773, with a life of Dr Bevis. 183. *Réflexions sur les comètes qui peuvent approcher de la terre*, 8. Par. 1773. 184. *Lettre à Cassini sur l'anneau de Saturne*, 8. Toulouse, 1773; a violent attack, which was speedily suppressed by the author. 185. *Ephemerides*, 3 vol. VII. VIII. IX. Paris, 1774, 1792. This was a continuation of Lacaille's computations, containing also some detached articles of importance; for instance, *Hampstead's catalogue*, in the eighth volume. 186. *A celestial* 12-*inch globe.* Paris, 1775.

187. The *Astronomical articles* in the *Supplement* of the *Old Encyclopédie*, about 1776: those of Dalembert, in the body of the work, having been little more than extracts from Lemonnier. 188. To the *Encyclopédie Méthodique* Lalande contributed a *Dictionary of Astronomy*, making about one-third of the *Mathématiques*, 3 vol. 4to. They were principally extracted from his own astronomy; and the article *Cadran*, which is very elaborate, was originally intended for a fifth volume of that work.

189. *Traité des cannaux de navigation*, f. Paris, 1778. This volume is principally descriptive, and especially of the canal of Languedoc. 190. *Letter on the variation of the compass, as connected with the temperature of the earth*, *Journ. Sav.* 1780. Sept.

Lalande || Lambert.

191. *Leçons d'astronomie de Lacaille*, 8. Par. 1780. With some Notes. 192. *Astronomie, in Bibliotheque des Dames*, 12. Par. 1786, 1795.

193. *Letter on the name of the planet Herschel*, *Journ. Sav.* 1789. Objecting to "Uranus." 194. *Description d'une machine de M. Ramsden*, 4. Paris, 1790. The dividing engine, translated. 195. *Account of nine Lalandes*, *Journ. Sav.* Nov. 1791. 196. *Journey to Mannheim* in 1791. *Journ. Sav.* 1791. 197. *On the zodiac at Strasburg*, *Journ. Sav.* 1791.

198. *Abrégé de Navigation*, 4. Paris, 1793. With a full catalogue of works relating to the subject, and many useful tables. 199. *A Journey to Mont Blanc*, performed in 1796. *Mag. Encycl.* II. iv. 433. 200. *Histoire Céleste Française*, I. 4. Par. 1801. Containing the catalogue of stars begun by Dagelet, and continued by Michel Lefrançais Lalande, the nephew of the editor. 201. Continuation of Montucla's *Histoire des Mathématiques*, 2 v. 4. Par. 1802; making the third and fourth of that elaborate work, but not equally well digested and discussed with the original part. 202. *Tables de Logarithmes*, 18. Par. 1802. 203. Four memoirs *on Ceres*, *Journ. Phys.* 1802. 204. Some articles in the *Nurologe des hommes célèbres*. He wrote, at different times, accounts of the lives of *Vicq d'Azyr*, *Delisle*, *Commerson*, *Ferron*, *Me. Lepaute*, and *Dubocage*; and he had undertaken a life of *Bucholz*, a short time before he died: Commerson had complimented him by making a genus Lalandia, trangressing in his favour the classical canon of the Botanists, to reserve such honours for the reward of merit in their own department.

205. *Bibliographie Astronomique*, 4. Paris, 1803. With a history of the *Progress of Astronomy* from 1781 to 1802. This useful volume was printed at the public expence, under the auspices of François de Neufchateau. The author possessed a very extensive collection of astronomical books, and it has been regretted that he did not insert a more complete account of some of the most rare; but the work is already sufficiently voluminous. Some other productions are attributed to him in the *Dictionnaire des Anonymes*; but they would probably have added little to his fame, had they been acknowledged.

(Delambre, *Mém. Inst.* VIII. 1807. H. P. 30, and *Biographie Universelle*, XXIII. 8. Paris, 1819. Ma. C. de Salm, *Magaz. Encycl.* 1810, ii. P. 288; including a sketch by himself, written in 1804.)

(E. X.)

LAMBERT (John Henry), a natural and moral philosopher of great talent and originality, born 29th August 1728, at Mulhausen in Upper Alsace, was the son of a French refugee in a very humble station, and one of a numerous family.

His early studies were only assisted by the instruction he obtained at a small free school in his native town. His father, who was a tailor, could scarcely even afford him leisure from mechanical labour; he was obliged to read and write in the night, and in order to procure candles, he made little drawings for sale, while he was watching the cradle of his infant sisters. Having learned to write a good hand, he obtained some employment as a copying clerk in the chancery of the town, which he gave up, when he was only 15, upon being appointed book-keeper at some iron-works in the neighbourhood. At 17, he became secretary to a Doctor Iselin, who was the editor of a newspaper at Bâle, and who became his firm friend through life. He had now time to render himself familiar with the works of Wolf, Locke, and Malebranche, to which he was in a great measure indebted for the correct logical method that he ever after followed in his researches; having, however, confirmed and improved it by the study of the mathematics, to which he devoted himself with great zeal, and which, after all, constitutes the best practical school of genuine logic.

Lambert.

In 1748, he removed to Coire, having been recommended by Iselin, as private tutor to the family of the President Count Peter de Salis, whom he undertook to instruct in history and religion, as well as in languages and science. The library of his patron was extensive; he profited by it in all its departments; and his residence at the house of an accomplished statesman, frequented, as it was, by the best informed persons of different countries and with different pursuits, could not but greatly contribute to the extension of his knowledge, and the improvement of his taste. He even amused himself with some poetical exercises in various languages, which must, at least, have been of advantage to his style in prose. He felt the importance of his literary and scientific pursuits to himself and to the world, and in 1752, he determined to keep a journal of all his studies, which he continued throughout his life; he began to publish a variety of fugitive pieces, on different subjects, in the newspapers and in other periodical works of the day, some of which attracted the notice of his learned countrymen, and, in 1754, he was made a member of the Physico-medical Society, then lately established at Bâle, to the *Transactions* of which he contributed many interesting papers. In 1756 he went to Gottingen with two of his pupils, and in 1757 to Utrecht. The next year the party returned to Coire, by way of Paris, Marseilles, and Turin. At Paris he paid a visit to Dalembert, who does not appear at that time to have appreciated his merit very highly, though he afterwards rendered him some services with the King of Prussia; but he became more intimately acquainted with Messier the astronomer.

In 1759 he quitted the family of the Count de Salis, and went to settle at Augsburg, having a small salary as a member of the Electoral Academy of Bavaria. From 1761 to 1763 he was again at Coire and in its neighbourhood, being employed in fixing the boundaries between the country of the Grisons and the Milanese territory. Towards the end of 1763, having had some disputes with the Bavarian academicians, he went to Leipzig, and the next year to Berlin, where he was made a member of the Royal Academy of Sciences, and where he continued to reside during the remainder of his life, receiving many marks of favour from the discriminating liberality of Frederic: thus, in the year 1770, he was made superior counsellor of the Board of Works, with an additional salary. He contributed a num-

Lambert. ber of valuable memoirs to the collection of the Academy; and in 1774 he undertook the direction of the *Astronomical Almanac,* for which he was admirably qualified. He was also a constant writer in the journal published by Nicolai, under the title of the *Universal German Library;* and he kept up a very extensive correspondence on various subjects of literature and science.

He was regularly in the habit of writing or reading from five in the morning till twelve; and again from two till midnight; a degree of application unquestionably far beyond that which would have been best calculated for producing the maximum of valuable effect.—Perhaps, if he was paid for writing by the ream, he may have earned as much from the booksellers as he would have done by a more judicious economy of his powers; but a nervous system, attenuated by the daily study of 17 hours, could never have been capable of being employed in any very elevated flights of genius, or in the invention of any sublime or exquisite novelties either in science or in literature: and it is only wonderful that he did any thing so well, as almost to form an exception to this general remark. He was indeed supposed to have injured his health by continued application, and he died consumptive at 49, the 25th September 1777. He had never been married. His person was of the middle size, with an interesting and expressive countenance; he was animated and lively in conversation, and liked discussion, but not disputation. He had no literary quarrels; and his criticisms were not offensive, even when they ceased to be flattering. His morals were strictly correct, but his manners were not altogether in unison with those of the society to which his talents had elevated him: he is said to have been timid, awkward, slovenly, and fond of low company; but upright, patient, unostentatious, and compassionate; essentially modest, but as ready to assert his own merits, as to admit his defects. He had a happy facility in managing the instruments of computation, especially in the arrangement of converging series; and he had a peculiar talent for expressing the results of observation by an analytical formula; having first thrown them into the form of a geometrical diagram to assist his invention; a process which he employed with regard to the probabilities of life in London, and to the inequalities of Jupiter and Saturn. In short, after Euler, Lagrange, Dalembert, and Daniel Bernoulli, there are few mathematicians and natural philosophers of any age who can be put in competition with him, and still fewer who benefited the public by so many diversified labours.

It would be hopeless to attempt to pursue his indefatigable pen through all its wanderings; and a complete catalogue of his works would be as useless as it is unattainable. A man who wrote so incessantly must have written many things which were destined to oblivion from their first production. It will be sufficient to mention the most remarkable of his works, without any very strict regard to the priority of their publication.

1. In the *Acta Helvetica of the Society of Bâle,* II. 1752, we find an *Essay on the force and measurement of heat,* a subject which the author resumed in the latter part of his life. 2. *A general series,* somewhat resembling Taylor's. *Act. Helv.* III. 1758. 3. *Meteorological observations. Ibid.* 4. He also published a paper *On the vibration of chords* in the same collection.

5. *Les propriétés les plus remarquables de la route de la lumière par les airs, et en général par plusieurs milieux réfringents.* 8. Hague, 1759. German by Tempelhof. Berl. 1773. This work does credit to the ingenuity and mathematical abilities of the author, though its results may be obtained in a simpler manner by some methods more recently invented.

6. *La perspective libre.* 8. Zurich, 1759. Another edition, in German. The second German edition, 2 v. 8. Zurich, 1773, contains some additional matter, especially a system of geometry, depending, as it is said, upon the ruler alone, without any other instrument. Such a system must, however, have been extremely limited in its application, much more so than Mascheroni's *Geometria del Compasso.*

7. *Photometria, sive de mensura et gradibus luminis colorum et umbrae.* 8. Augsb. 1760. This original and interesting volume includes and supersedes the greater part of Bouguer's experimental determinations. It contains the important discovery that a luminous surface emits its light with equal intensity in all directions; together with some improvements in the theory of twilight, and an investigation of the comparative light of the sun and moon, and stars and planets.

8. *Insigniores orbitae cometarum proprietates,* 8. Augsb. 1761. We here find the elegant theorem for expressing the relation of the area of a sector to the sides of the triangle inscribed in it. This theorem had been demonstrated with respect to the parabola by Euler, in 1740; but Lambert first extended it to the other conic sections; and he certainly reinvented the whole, without being aware of what Euler had done. It may be found, together with a concise demonstration, and a further account of this work, in the translation of Olbers's *Essay on Comets,* which has lately been published in the *Journal of the Royal Institution.*

9. *Cosmologische Briefe.* 8. Augsb. 1761. A French translation of these *Letters on the Universe* appeared in the *Journal Helvetique of Neuchâtel,* 1763-4; an extract was published by Merian, with the title of *Système du Monde,* 8. Bouillon, 1770; Berlin, 1784; and a translation by Darquier appeared at Amsterdam, 8. 1801. The whole work is written in a popular style, and adapted to the taste of general readers. The author's favourite idea was to make the sun a sort of planet, revolving round some other great body; and he supports the opinion by an argument derived from the supposed insufficiency of the laws of gravity, as relating to the solar system, for explaining some of the inequalities of the motion of Jupiter and Saturn, which have, however, since been reduced to the general analogy by Lagrange and Laplace.

10. *Zusätze zum traité de nivellement Von Picard,* 12th August 1761, explaining some improvements on Picard's level, executed by Brander, an ingenious artist whom Lambert also assisted in the improvement of Gunter's sliding rule. 11. He published an

Lambert. explanation of this scale, entitled, *Logarithmische rechnung*, 12th August 1761.

12. [illegible] *incommensurable quantities*, *Mem. Ac. Berl.* 1761. A demonstration of the incommensurability of the circumference of a circle to its diameter, which has been adopted by Legendre in his geometry. It depends on the method of reducing a fraction to its lowest terms, as laid down by Euclid, and on the properties of continual fractions, an expression is obtained for a tangent in terms of the arc from the quotient of the series for the sine and cosine, and the continual fraction thus obtained is proved to be infinite. It is also shown, that the ratio of the arc to its tangent can never be expressed by any finite quadratic surds. 13. *On the specific gravity of salt, and of its solutions*, *M. Berl.* 1762.

14 *Novum organum*, 2 v 8. Leipzig 1763 In German An attempt to restore and improve the Aristotelian method of syllogism, in which the author is allowed to have displayed much ingenuity, though its success was greatly limited, on the one hand, by the sober good sense of the empirical reasoners of the school of Bacon and Locke, and, on the other, by the wild enthusiasm of the German innovators, who were beginning to be intoxicated with the high sounding phrases and exaggerated pretensions of the disciples of Kant A manuscript Latin translation of the work, by Pfleiderer, was once in the possession of the late Lord Stanhope.

15 A paper *On trigonometry* appears in the *Nova Acta Eruditorum* for 1763. 16. In the *Berlin Memoirs* for the same year, we find an *Essay on acoustic instruments*, investigating the best forms for hearing trumpets 17. *Remarks on the properties of equations of all degrees.* 18. *On divisors of equations, which may be found without solving them.* 19. *On some measurements relating to the intellectual world*; that is, on probabilities and expectations

20 *Beytrage zur mathematik*, 4 v. 8 Berlin, 1765 1770, 1772. A collection of essays on every department of mathematical science. The first volume contains *Remarks on trigonometry*, and *on the certainty of observations*; *On the divisors of numbers*, and *On annuities*: the second, *Tables of the moon*; *An essay on dialling*, and *On geographical projections*, with the *Elements of Tetragonometry*, a subject which was afterwards resumed by the younger Mayer; in the third volume, there is an *Essay on interpolation*, *Remarks on celestial maps*, with other articles.

21. *Description of a table of eclipses*, Berl. 1765, with the easiest mode of computing them. 22. In the *Memoirs of the Academy of Berlin* for 1765, we have a paper on *Projectiles*, including the effect of resistance. 23. In those of the *Bavarian Academy* for the same year, some remarks *On the improvement of terrestrial measurements*, and, 24. *Meteorological observations.* 25. In the *N. Acta Erud.* for 1765, *An attempt to employ calculation in the moral sciences.* 26. *On the magnet.* *Ac. Berl.* 1766. 27. Another paper *On magnetic currents.* 28. *A magnetic chart* was published separately the same year. 29. *Remarks on the general outline of the ocean.* *Ac. Berl.* 1767. 30. *A general solution of the problem of three bodies by means of series.* *Ibid.* 31. *Notes on Richer's philosophical algebra*, 1767.

32. *Remarks on the velocity of sound.* *M. Ac. Berl.* 1768; an unsuccessful attempt to reconcile the theory with observation; it was reserved for Laplace, by a single happy suggestion, to remove the whole difficulty. 33 *On photometry, as applied to painting.* *Ibid.* 34. *Trigonometrical observations.* *Ibid.* Lambert.

35. *De Topicis Schediasma*, 1768. 36. *Remarks on the divisors of numbers.* *Nov. Act. Erud.* 1769. 37. *Anmerkungen über die Branderschen micrometern*, Augsb. 1769. Brander's micrometers were of glass.

38. *Experiments on Hygrometry.* *M. Acad. Berl* 1769; relating to evaporation, and to the indications of hygrometers, especially those of catgut.

39. *Supplementa tabularum logarithmicarum*, 8 Berl. 1770 With a valuable introduction in German, on the abridgment of computations.

40 *Anmerkungen über die kraft des Schiesspulvers*, 8 Berl. 1770. In this investigation of the force of fired gunpowder, the author attacks several points in the theory of Robins, published a few years before.

41. *Hygrometrie*, 4. Augsb 1770.

42. *On directors for the light of lamps.* *M. Acad Berl.* 1770. 43. *On ink and paper* *Ibid.* 44 *Analytical observations.* *Ibid.* relating to the general theorem resembling Taylor's, which was further discussed by Euler, and modified by Lagrange 45 *On Taxeometry, or the measurement of order.* *Ibid.* considered as comparable in degree, and expressible by numbers.

46. *Architectonik*, 2 v. 8. Riga, 1771. A logical and metaphysical treatise on the most simple bases of philosophical and mathematical knowledge, written in 1763. The last part, which relates to magnitude, is the most approved; but the whole work was never much read, being partly superseded by the more ostentatious novelties of the day.

47 In the *Berlin Memoirs* for 1771, we find papers on *Meteorology* 48. *On the atmospheric influence of the moon.* 49. *On achromatic telescopes of one kind of glass only.* 50 *On the apparent paths of comets* 51 *On the grounds of superstitious belief, as compared with probability*

52 *Ueber das Farbenpyramide*, 8. Berl. 1772. A description of a pyramid of wax, intended for the illustration of all the possible varieties of combination of the primitive colours.

53. *Astronomisches Jahrbuch*, 8. Berl. 1774-9. An accurate and extensive ephemeris, with many original communications annexed to it.

54. In the *M A. Berl.* 1772, a paper *On Friction* supposed to follow the law of the resistance of fluids, with some remarks on that resistance The opinion of the uniformity of the force of friction, which was even at that time general, was somewhat too hastily rejected by the author: but his computations may still be of use in some cases. 55. *On the fluidity of sand* · as resisting motion. 56. *On hygrometry* continued. 57. *On the density of the air*, with respect to sound and to refraction.

58. *M. A. Berl.* 1773 *A Balistic scale*: for determining the paths of projectiles in the atmosphere 59. *Physical observations*, relating to Meteorology and to Optics. 60. *On the satellite of Venus*: af-

Lambert. Lamps.

fording a remarkable instance of misapplied labour and ingenuity. 61. A second essay on Photometry. 62. *A note on the inequalities of Jupiter and Saturn*, intended to confirm the principles advanced in the cosmological letters: the detail was reserved for a subsequent volume.

63. *M. A. Berl.* 1774. *On the temperament of musical instruments.* 64. *On aerial perspective.* 65. *Report on a bedstead for sick persons.*

66. *M. A. Berl.* 1776. *On the elasticity of the air.* 67. *On windmills, and on the force of the wind.* 68. *On the sounds of flutes.* An elaborate comparison of the various tones of a flute with the theory of Daniel Bernoulli for determining the sounds of compound organ pipes.

69. *M. A. Berl.* 1776. *On the strength of men employed in labour.* 70. *On imperfect fluids.*

71. *M. A. Berl.* 1777. *On the elasticity of the air.*

72. *M. A. Berl.* 1779. Two Memoirs *on the inequalities of Jupiter and Saturn.*

73. *Pyrometric*, 4. Berl 1779: A posthumous work, upon a subject which had long occupied the author's attention: with a *Preface* by Karsten, and a *Biographical Memoir* by Eberhard.

74. A paper on *Annuities*. *Leipz. Magaz.* 1780

75. *Deutscher Gelehrter Briefwechsel.* 5 v. 8. Berl. 1781–7. Published by John Bernoulli; consisting principally of the author's correspondence with Holland, Kant, Karsten, Segner, Basedow, Scheibel, and Brander. The contents are more fully described by Lalande *Bibl. Astr.* p 584.

76. *M. A. Berl.* 1783. *On friction.*

77. *Logische und Philosophische Abhandlungen.* 2 v. 8. Berl. 1787. Edited by J. Bernoulli.

78. *On the theory of parallel lines. Hindenb. Arch der Math.* I.

(Bernoulli in *Nouvelles Littéraires.* 8. Berl 1777 Eberhard in *Pyrometrie Briefwechsel*, III. *Phil Mag* May 1804. Aikin's *General Biography*. VI. 4. Lond 1807. Servois in *Biographie Universelle*, XXIII. 8 Par. 1819.) (A. L.)

LAMP, is a name applied to various contrivances for furnishing artificial light. We shall, in addition to what is said under this head in the *Encyclopædia*, offer some remarks on the various kinds of Lamps for ordinary purposes, on Lamps for Light-Houses, on Lamps for Streets, and on the Safety Lamp.

Substances used for burning

Lamps are usually fed by expressed oils from vegetable or animal substances In Britain, whale oil, boiled from the subcuticular fat of the whale, is used for common lamps.

Tallow is one of the most common substances employed for giving light. The spermaceti, which is found near the nervous substance of the spinal marrow in a particular kind of whale, is also used There is a substance resembling spermaceti, formed by the decomposition of the muscular flesh of animals in moist places, which has been employed. Bees-wax, a vegetable substance collected by the bee, and which, in some of its qualities, resembles the essential oils, is one of the best materials for giving light.

In no region of the globe are human beings found to exist without a supply of oil derived from animals or from vegetables; and in the more fertile regions several different plants, peculiar to each region, are cultivated on account of the fixed oil which is extracted from their seeds by pressure. These oils vary in quality. The oils fit to be employed in food are the most valued. Of the rest many have the qualities which fit them for burning in lamps.

At Paris, oil of rape-seed, and oil of poppy-seed, are clarified for the lamp by filtering through cotton, wool, and other processes. In the south of France and Italy the inferior kind of olive oil is used in lamps, and sometimes the oil of the plant called *Arachis hypogæa*, or earth-nut. In Italy, lamp oil has been pressed from the stones of the grape. In Piemont, walnut oil is used for lamps On the eastern and south coasts of the Mediterranean, and in China, the inferior kind of oil of sesamum In tropical countries, cocoa-nut oil, which, in the temperature of heat of Britain, is solid and white like tallow. It is burnt in lamps made of the shell of the cocoa-nut, and of bamboo. Much of the oil used in China is obtained by expression from the seeds of the tree called by botanists *Camellia oleifera*, which is extensively cultivated for that purpose; as is the shrub called *Croton sebiferum*, for the solid oil or tallow that the Chinese press from its fruit. Essential oils, extracted from plants by distillation, are too volatile, and, in consequence of their volatility, are too easily inflamed.

Petroleum and naptha issue from the earth in several places, and these sources are generally in secondary strata, and originate from fossil vegetable matter in a state approaching to that of pit-coal. A source of petroleum existed some years ago near Colbrook Dale, and at St Catherine's near Edinburgh The greatest natural deposits of petroleum and bitumen are in the Island of Trinidad, and in the Dead Sea in Judea. Naptha is the most liquid of the oils proceeding from fossil vegetable matter, and possesses qualities very fit for burning in lamps It is employed for this purpose at Genoa, where the streets are lighted with naptha from Amiano in the adjacent territory. Naptha, obtained in the state of a clear colourless liquid, by distillation from pit-coal, has of late been employed for burning, in street lamps, in London.

Alcohol or spirit of wine, being more clean than oil, is convenient for feeding a lamp that serves to heat a liquid in a small vessel; but the flame is blue, and therefore is not suitable for giving light.

In a spirit lamp, the surface of the spirit must be covered to exclude the air, for the spirit would catch fire if its surface were exposed.

Sulfuric ether is too easily inflamed, and too costly to be used for feeding lamps.

The Wick

In a lamp, for the purpose of giving light without a considerable quantity of heat, it is required that only a small portion of the oil shall be inflamed at once; therefore, by means of the wick, a small portion of oil, minutely divided so as to expose a large surface, is subjected to the action of the heat; the heat decomposes the oil, and the gas resulting from the decomposition is burnt by the atmospheric air which surrounds the wick. In the gas lights, which,

within the last few years, have come into use in many manufactories and cities in Britain, the operations of producing the gas and inflaming it, which take place at one time in the wick of a lamp, are performed separately. The gas is obtained from pit-coal, oil, or wood, but best from pit-coal or from oil, by heating these substances strongly in a retort; and when extricated, is conveyed away in pipes to the place where it is to be inflamed. The capillary attraction of the filaments of the cotton which compose the wick, raises up a small portion of oil into a situation where it may be exposed to the degree of heat necessary for producing flame.

In lamps of the most common structure, the wick should not be elevated too high above the surface of the oil, for, in that case, the capillary action by which the oil rises between the filaments of the cotton will not be able to raise it to so great a height. If the wick is too little elevated above the surface of the oil, there will not be a sufficient quantity of the oil converted into the gas, whose combustion constitutes the flame, and the flame will be too small.

Many lamps used by the Greeks and Romans, have been found in the ruins of ancient towns. These ancient lamps are of pottery, painted and sculptured with various ornaments, and of bronze. The surface of the oil in the reservoir is nearly on a level with the lighted part of the wick, which emerges from a projecting beak at the side of the reservoir.

Varieties in the Structure of Lamps.

The lamp commonly used in rooms at Florence consists of a round reservoir, with four beaks projecting from four opposite points of its circumference: through the middle of the reservoir a vertical stalk passes; and on this stalk the lamp may be raised or slid down. The stalk is fixed in a foot that rests on the table. The whole is made of brass.

A lamp, which affords a faint light, is made of a waxed wick, an inch long, passed through the centre of a thin round piece of cork, and of a piece of card placed above the cork. Some oil is placed on the surface of water in a glass tumbler, and the cork, with its wick, is laid upon the surface of the oil. This lamp, called a *veilleuse*, is commonly used in Paris for burning in bedrooms during the night, as rush lights are in London.

The lamp with a hollow cylindrical wick, which receives a current of air, both on the outside and the inside of the cylinder, is called, in England, an Argand lamp, from the name of one of the first makers. The principle of this lamp is described in the *Encyclopædia*. The wick in Argand's lamp, as first constructed, was raised by a rack and pinion; but the method now employed to raise the wick consists in a spiral notch, which goes round outside of the interior tube. The inside of the ring to which the wick is attached has a tooth which fits into this notch.

At fig. 2, Plate XCIV., is a representation of the most usual form of the Argand lamp. A is a reservoir, which is air tight at top, and has the neck immersed in oil, so that oil flows out of it only when the external air is admitted to ascend through the neck: it contains a short column of liquid, from the top of which the pressure of the atmosphere is excluded, and therefore the column is sustained by the weight of the atmosphere pressing on its base, on the same principle as a bird-cage fountain.

Oil is introduced into the reservoir A, by taking it off, and holding it with the neck uppermost. The sliding tube Q is pushed so as to uncover the hole *t*, and the oil is poured in by the hole *t*; when this is done, the hole is again covered by the sliding tube, and the reservoir A is replaced in F. When the lamp is to be lighted, the hole *t* is opened by depressing the sliding tube by its handle *z*, and the oil will flow out of A till it rise in F, and in the annular cavity that contains the wick to the level of the top of the hole *t*. When the oil in F is lowered by the burning of the lamp, so that the surface of the oil in F is below the upper part of the hole; then a bubble of air ascends into A, and a quantity of oil descends into F, till the surface of the oil rises again to cover the upper part of the hole. It sometimes happens that the air in A is heated by the warmth of the room, and then too great a quantity of oil descends into F, in consequence of the expansion of the hot air in the upper part of A, so that the oil, not being all consumed in the wick, falls down through the tube *g*, and may even run over from the cup P. This is a considerable inconvenience attending oil reservoirs of the construction here mentioned. The hole *t* is closed by drawing up the sliding tube Q, when the lamp is not burning, in order that the lamp may be inclined, without making the oil descend from the reservoir.

The cylindrical part, where the flame is produced, is composed of three tubes, *d*, *f*, *g*. The tube *g* is soldered to the bottom of the tube *d*, just above *o*, and the interval between the outer surface of the tube *g* and the inner surface of the tube *d*, is an annular cylindrical cavity closed at bottom, containing the cylindrical cotton wick immersed in oil. The wick is fixed to the wick tube, which is capable of being moved spirally; within the annular cavity is also the tube *f*, which is capable of being moved round, and serves to elevate and depress the wick. P is a cup that screws on the bottom of the tube *d*, and serves to receive the superfluous oil that drops down from the wick along the inner surface of the tube *g*. The air enters through the holes *o o*, and passes up through the tube *g* to maintain the combustion in the interior of the circular flame. The air which goes to perform the combustion on the exterior part of the wick enters through the holes *m*, with which *r s* is perforated. When the air in the chimney is rarified by the heat of the flame, the column of the atmosphere, of which the chimney is the base, becomes lighter than the surrounding columns; and the surrounding columns, pressing with their excess of weight, enter the lower part of the chimney, and pass upward, with a rapid current, to restore the equilibrium between the adjacent columns of the atmosphere.

In some lamps, above the orifice of the tube *g*, and nearly at the height of the top of the flame, there is placed a circular plate of metal, of the same diameter as the tube: this has the effect of turning the

Lamps current of air into that part of the flame where smoke would otherwise be produced. The same effect is obtained by the contraction of the cylindrical glass chimney at R G: the contraction of the chimney was commonly employed in Paris before it was used in England.

The oil flows from the reservoir A and F through N, and occupies the cavity between the exterior surface of the tube *g*, and the inner surface of the tube *d*. The oil rises in the annular cylindrical cavity between these two tubes to the level of the opening *t*. The part *w i* is a short tube, which receives the circular wick, and slides freely on the tube *g*. The tube *g* has a hollow spiral groove on its exterior surface, into which enters a pin *k*, connected with the wick-tubes *w i*. The wick-tube has a catch, which works in a perpendicular slit in the tube *f*, and, by turning the tube *f*, the wick-tube will be raised or lowered; *r n* fits on the tube *t*; *r n* is fitted to receive the glass chimney R G, one of which is seen at *s*; a wire *s* is attached to the tube *f*, and is bent over the edge of the tube *d*, and descends along the outside of the tube *d*. The part *n r* that supports the glass chimney, is connected, by four other wires, with the ring *y*, which surrounds the tube *d*, and is capable of being moved round. When *n r* is turned round, it carries round along with it the ring *y* the wire *s*, and the tube *f*, and thereby operates the elevation and depression of the wick.

The glass chimney which rests on R N is wider at bottom, and then is contracted at R G, for the purpose of making the air rush upon the external part of the circular flame in a denser current.

In the most simple construction of lamps the surface of oil in the oil reservoir is nearly on a level with the flame, because the capillary attraction of the wick can only raise the oil a little above the surface of the reservoir. The surface of the reservoir also is considerable, that the lamp may burn for a sufficient length of time, before it has consumed so much oil as to reduce the level of the oil below the reach of the action of the capillary attraction of the wick. Mechanists have contrived and executed lamps of various forms, with the view of removing the inconvenience of the shadow of the reservoir which is inherent in the common lamp with one lateral beak.

One of the contrivances for diminishing the bulk of the part in which the wick is immersed, and for obtaining a supply of oil, is the bird-cage fountain reservoir described above, as being usually applied to argand lamps. This kind of reservoir is described by Cardan, and a lamp fed by it is mentioned by several writers under the name of Cardan's lamp.

Baptista Porta, in treating of oil reservoirs of the kind just now mentioned, proposes that, for large lamps with many wicks, the reservoir should be placed above and without the room, and should communicate with the lamp within by a pipe. In this way, the oil would not be liable to be pressed out too rapidly by the expansion of the air in the reservoir occasioned by the heat of the room; and several methods have been contrived for the purpose of placing the luminous part of the wick on the upper end of a stalk, so that very little of the sphere of rays, proceeding from the lighted wick, may be intercepted by the opaque part of the lamp. The following are some of these methods: Lamps.

A lamp, called the Amiens lamp, commonly used in Paris by the poorer classes, is in the form of a candle. The lighted part of the wick is at top; the lower part of this cylinder, which is of tin, has a valve opening upwards, and is moveable up and down in another cylinder, which has a valve opening upwards. This valve is plunged in the reservoir of oil; when the wick is in want of oil, the oil is pumped up by moving vertically the tin cylinder which contains the wick. Lamps of this kind are described in the *Transactions of the Academy of Sciences* for 1755, p. 139, and for 1760, p. 158.

A lamp for reading is made by Carcel of Paris in which the oil is raised to the wick by means of a pump. The pump is moved by watch-work, composed of wheel and pinion, and a spring, which is wound up when the lamp is to be lighted.

In the XXth Vol. of the *Philosophical Transactions*, St Clair, in a letter to Hooke, describes a lamp, in which the oil floats on water. A tube passes from the upper part of the vessel down to the water, and through this tube water is dropped, by means of which the surface of the oil is always maintained at the same level, whilst it is consumed by the flame in the wick.

In the lamp constructed by Mr Kier of Kentish Town, the oil is raised to the wick, and sustained by a column of a solution of salt in water. This liquid, being of a greater specific gravity, a column of it counterbalances a longer column of oil. The solution of salt is made of such a specific gravity, that it will support a column of oil four-thirds of its own height. This is nearly the specific gravity of the heaviest saline solution that is known to exist in any great body of natural water, namely, in the Dead Sea, the weight of the waters of this sea, of distilled water, and of oil, being in the relative proportions of 120, 100, 92. To have an idea of this lamp, imagine a syphon with two upright branches, and the junction of the branches at the bottom. The shortest branch has a bulb at top. The longest branch has a bulb near its lower extremity. The shortest branch is filled with a solution of salt, whose upper surface is in the superior bulb. The longer branch contains the oil, and in its upper extremity the wick is placed. In the lower bulb the surface of the oil rests upon the surface of the solution of salt.

The bulbs serve as reservoirs, prolonging the action of the machine; by means of the bulbs and the greater specific gravity of the solution, it is effected, that the abstraction of a considerable quantity of oil by the combustion in the wick occasions but a small depression in the upper surface of the solution; the height of the sustaining column of solution will become shorter in proportion as the column of oil which it counterbalances is consumed; but this diminution of the height of the column of oil will be slow, and therefore the column of oil will for a considerable time be of sufficient length to reach the wick. Suppose an inverted syphon, of

equal diameter throughout, the shorter leg of which contains a column of solution of salt, whose height is 75, and this counterbalances a column of oil, whose height is 100, in the longer leg, if now the column of oil in the longer leg be diminished in height by 10, the counterbalancing column of solution will diminish to 67.5, being 7.5 shorter than at first. But if the syphon, instead of being of equal diameter, has two dilatations or reservoirs, whose horizontal section is ten times the area of the tube of the syphon, one of the reservoirs being placed at the top of the short branch, so as to contain the upper surface of the solution of salt, and the other at the bottom of the long branch, so as to contain the surface where the oil rests upon the solution, then, if the same quantity of oil, as in the former example, is taken from the top of the longer leg of the syphon, the column of oil will only fall one-tenth of what it did in the undilated syphon of equal diameter, and the solution of salt will diminish one-tenth of what it did in the syphon of equal diameter.

The oil reservoir and the wick remain stationary, and do not descend as the oil is consumed. This descent takes place in two lamps now to be mentioned, because in these two lamps the oil reservoir swims in liquid that acts as a counterpoise.

In the lamp contrived by the Chevalier Edelkrantz of Stockholm, the oil reservoir floats in mercury, and the column of oil is maintained at the requisite height by the counterpoise of a column of mercury; in proportion as the oil is consumed, the oil reservoir and the wick which is connected with it sink.

The general structure of this lamp may be understood by conceiving a flask, with a long narrow neck, and enlarged at the under part. The flask is heavy enough to swim, when it is placed in mercury, with part of its under part immersed. The bottom of the flask is open. The flask being placed in mercury, is made to float with its neck perpendicular. Oil is poured in at the neck till the flask is full. Then the surface of the mercury at the bottom of the flask and within the flask will be depressed by the weight of the column of oil that rests upon it; and the surface of the mercury on the outside of the bulb or lower part of the flask will stand higher than the surface of the mercury within the flask. The height which measures the difference of level of the two surfaces of mercury, will be the height of a column of mercury of equal weight with the column of oil that is in the flask; and as mercury is about $14\frac{5}{10}$ times the weight of oil, the difference of level of the two surfaces of mercury will be [illegible] of the height of the oil in the flask. In proportion as oil is abstracted from the upper end of the tube by the combustion in the wick, the height of the column of oil is thereby diminished, and the two surfaces of mercury will come nearer to each other, the flask sinking a little in the mercury. As the area of the horizontal section of the lower part of the flask is much greater than the area of the section of the neck, and as the specific gravities of mercury and oil are very different, it follows, that, to restore the equilibrium after the abstraction of a column of oil from the wick, the surface of the mercury within the lower part of the flask will rise by a much shorter column.

In the lamp invented by Mr Barton, Comptroller of his Majesty's Mint, a solution of salt in water is used as a counterpoise to the oil. The combination consists of a light flask, open at the bottom, floating in a solution of salt, so that, when oil is poured into the flask, the surface of the oil in the neck of the flask stands at a higher level than the surface of the saline solution, in which the flask swims. The wick is at the upper end of the neck of the flask, and as the area of the horizontal section of the bulb or lower part of the flask is much greater, suppose 20 times greater, than the area of the section of the neck of the flask, it will happen, that when a column of oil an inch high is abstracted from the neck of the flask, the height of the rise of the surface of the solution in the bulb or lower part of the flask will be only $\frac{1}{20}$th of an inch. This lamp is represented at fig. 3, Plate XCIV.

T is the oil reservoir, from which the oil passes upwards to the wicks w, w, w. The oil reservoir is open at bottom, at h. This is preferable to the mode of making the reservoir with a perforated bottom, that screws off, for the purpose of cleaning the reservoir. The fluid B, in which the oil reservoir is immersed, is a solution of salt in water. This liquid is contained in a vessel RMO, which can be unscrewed at O, for the purpose of taking out the oil vessel. N and Y are two floats fixed to the oil reservoir and its tube. The column of the solution of salt c, h, presses against the oil at the open bottom of the reservoir, and maintains a column of oil in the tube to the height e; to this point e the wick descends, and raises the oil to the flame by the capillary attraction of its fibres. The specific gravities of the oil and the solution of salt must be inversely as the heights c, h, and h, e, that is, the specific gravity of the solution of salt must be made to bear to the specific gravity of the oil the same proportion that the perpendicular height c, h, bears to the perpendicular height c, h. As the oil is consumed, the water enters the hole at the bottom of the oil vessel, the surface of the water at c sinks, and the oil reservoir, with the tube and wicks attached to it, sink also. The upper part of the vessel R should be of a capacity a little less than the capacity of the oil reservoir, so that, when the water has displaced the oil, and filled the oil reservoir, the float Y may be at the bottom of the enlarged part of the water vessel R. To prepare the lamp, the exterior vessel is filled with solution of salt by the opening at l; the solution passes into the oil vessel by the open bottom h, and the oil vessel rests on the bottom of the exterior vessel. The oil is then poured in through the tube e. The oil passes into the oil reservoir, expels the water, and floats the oil reservoir, raising the surface of the water in R.

An inconvenience affecting Barton's lamp is, that the solution of salt, by the gradual evaporation of the watery part, becomes more dense, and capable of supporting a higher column of oil than it did at first. The lamp of Edelkrantz, which floats on mercury, is not liable to this inconvenience, because the mercury does not alter in density by evaporation.

Lamps.

Both these floating lamps have the inconvenience, that the oil is made to run over at the wick by any accidental shock which depresses the floating part of the lamp.

Several lamps have been constructed in which the oil is raised by the principle of the fountain of Hero, of Alexandria, which is known as being employed to raise water in the mines of Chemnitz, in Hungary. In Hero's writings, the application of this machine to raise oil to a lamp is described. Lamps of this construction were made some years ago in Paris by Girard de Marselle. Of this kind is the hydropneumatic lamp made by King, tin and japan manufacturer, of Snowhill, London. This lamp is formed externally like a column, 18 inches high, and 4 inches in diameter; it is made to contain oil enough to last for five or six hours. An idea of its general principle may be formed by means of the diagram at fig. 5, Plate XCIV. in which there is a descending tube, with a bulb, at A, at top. The upper part of this bulb is open. The tube, at its lower part, is curved upwards, and dilated into a second bulb, B. The tube contains oil, the upper surface of which is in the upper bulb A, and its other surface is in the lower bulb B. From the top of the lower bulb B, a tube proceeds to the top of another bulb, C, placed higher than the upper bulb A, of the first tube. This third bulb, C, contains oil, and from the bottom of this third bulb the oil rises in a tube. At the upper end, W, of this tube, the wick is placed. The whole machine is closed, and air-tight, except at the openings of A and W, and at these openings the pressure of the atmosphere acts. Thus the column of oil contained in the first tube and bulbs A, B, presses, with its own weight, and the weight of the atmosphere, on the confined air contained between the second bulb, B, and the third bulb, C, and raises up a column of oil from that third bulb. The top of this column, so raised, is at a higher level than the top of the oil in the first tube, because the bottom of the column, which is raised, is at a higher level than the bottom of the column in the first tube. The whole machine is a syphon, in which a first column of oil, of the perpendicular height AB, supports a second column of oil, CW, not of a greater height than the first column, but, by means of the column of air, BC, interposed between the two columns of oil, it is effected that the extremity, W, of the second column of oil, is much higher than the upper surface, A, of the first column of oil. In the lamp constructed on this principle by King there is a plug and valve, which serve for introducing the oil, and other particular contrivances. When the oil is to be poured in, the lamp is inverted.

A lamp, of which the reservoir for the oil is in the form of a hollow ring, was contrived by Count Rumford, and is described by him in *Nicholson's Journal*, Vol. XIV. 1806, p. 23. The lamp is in the centre of the ring, with which it communicates by three straight tubes, in the direction of radii of the ring. The stoppers which close the apertures by which the oil is poured into the ring have a small hole, which allows the atmosphere to press on the surface of the oil in the ring, and thereby permits it to flow freely to the wick. This small hole may also be placed in some other part of the ring, and not in the stopper. The ring supports an hemispherical shade of roughened glass, or of gauze. These glass shades are made rough, not by grinding, but by laying a coat of powdered glass on the smooth surface of the shade, and then exposing it to the heat of a furnace, so that the powdered glass becomes adherent, and produces a rough or frosted surface. This method of frosting glass is practised in some glass-houses situated in that district of Staffordshire called the Potteries. Lamps of this construction may be suspended from the ceiling, or placed on a stand, and are now frequently used in rooms and shops in London and Paris. They are called in London French lamps.

Hooke, in his treatise entitled *Lampas*, published in 1677, describes eight contrivances for supplying oil to a lamp equably, and as long as there remains any oil in the reservoir. This he effects by different methods of counterbalancing the oil. These inventions display Hooke's ingenuity and great knowledge of mechanics, but require nice workmanship, and are not applicable to practical purposes. These counterpoises of Hooke also serve to form a vessel so that the whole liquid may be drawn from it in an equable stream, by tapping the vessel at the top, and to make the descent of the surface of a liquid and its discharge constant and equable, in a clepsydra for showing the hour.

Porter's automaton lamp, constructed in London in 1784, is something similar to some of Hooke's contrivances for producing an equable supply of oil to the wick, as long as there remains any oil in the reservoir. It does not require such delicacy of execution as his counterpoised lamps. Porter's lamp is a tin box, the vertical and longitudinal section of which is a rectangular parallelogram, elongated horizontally, of which call AB the two upper angles, CD the two lower. This parallelopipedal box is suspended on an axis near the upper surface of the box, at a place which may be denoted by X. The axis is nearer A than B; at A is the wick, and a tube going down to the bottom of the box, along the side of the box AC. When the box is full of oil, then the space XB, behind the axis, being full of oil, counterpoises the shorter space XA. AB, the long side of the box, is horizontal; and the line drawn from the axis of suspension down to the centre of gravity is perpendicular to AB. But, when the surface of the oil falls below the axis, then the box turns on its axis, the side A falls, and B is elevated; A being heavier, by reason of the wick and wick tube, and the side AC assumes a lower position, in proportion as the oil is consumed; the line drawn from the axis down to the centre of gravity becoming more and more oblique to AB. The operation of this lamp depends upon the position of the axis X, and the weight of the wick-tube, which must be accurately proportioned, the one to the other, by trial.

Lamps for Light-houses.

Lamps for Light-houses.

Light-houses are now generally lighted with Argand lamps, which have hollow cylindrical wicks placed before reflecting mirrors. Several of these

Lamps for Light-houses.

lamps are fixed on a frame, and protected from the weather by glass windows. The lamps of light-houses are fed with oil, and in some places with pit coal gas, as in a light-house near Trieste, afterwards mentioned.

In many of the light-houses on the British coast, the frame on which the lamps are fixed is made to revolve by means of clock-work, so that to a spectator, situated in the circle of which the light-house is the centre, the light appears at its brightest at the end of a stated period of time, which is generally one or two minutes. The revolving of the light enables seamen to distinguish the light-house from the light of lime-kilns or other fires upon the coast. This distinction is of great importance, for shipwrecks have happened in consequence of mistaking the light of lime-kilns for the light of a light-house. The light is, in some light-houses, made of a red tinge to distinguish it from some other light-house not far distant. The red colour of the light is produced by placing windows of red glass before the lamps. Red is the only colour that can be given to the light in this way. When stained glass of other colours is placed before the lamp, it is not found to produce a change in the colour of light seen at a distance; the blue or green colour of the glass becomes insensible when seen through a great body of air which has itself a blue colour.

Lamps for Lighting Streets.

Till within the last six years, the street lamps, used in London and in other parts of Britain, consisted almost uniformly of a deep inverted bell-shaped glass lantern blown of one piece, and suspended by the edge in an iron ring; with a tin conical cover perforated to give issue to the smoke, and within the lantern, a flat oil vessel with two or more wick holders or beaks, projecting from its circumference. Many districts of London are lighted with lamps of this form; other districts employ several kinds of street lamps of a different form. The first of these new kinds were made under the direction of Lord Cochrane, and employed to light the streets in the parish of Saint Anne, Soho, London.

The lanterns which serve to protect the light from wind and weather in the new lamps in one district of London, are composed of four lateral panes and a bottom of glass, joined together by sheet iron, so that the lantern is in form of a truncated pyramid, inverted like the lanterns of the street lamps in Paris. In lanterns of this form some light is intercepted, and a shadow is thrown on the street by the metal that unites the panes. This defect does not occur in the lanterns of street lamps most commonly used in England, and made of one piece of glass blown into the form of a spheroid. The spheroidal lanterns deflect the light more, because they are more unequal in thickness, but this is a smaller inconvenience: the lanterns blown of one piece of glass are more easily cleaned. Many of the lanterns for gas lights are also made of panes in the above mentioned form; some are cylindroids blown of one piece with a hole in the bottom to admit air. In some of the new lamps, in London, which have lanterns of one piece of glass, the form of the lantern is nearly cylindrical; in others, the lantern is not so deep as the lanterns of the old form. The new lamps have reflectors placed above the light, for the purpose of reflecting the light downwards on the foot pavement. These reflectors are of various forms, in some of the lamps, the four plane surfaces of the inside of the pyramidal cover of the lantern are made bright, and serve to reflect the light downwards. In other lamps the ceiling of the lantern is a reflector in form, having a small portion of a large curved surface with a chimney in the middle to give issue to the smoke. Others have two, and sometimes three, concave conoidal reflectors, whose vertices meet over the light, the axes of two of the reflectors being parallel to the direction of the street: at the point where the reflectors meet there is a chimney through which the smoke ascends. The reflectors require to be frequently wiped in order to keep them bright.

Lamps for Lighting Streets.

The oil vessels of the new lamps in London are of various forms; the beak, or part of the oil vessel under the wick, is made as narrow as possible, for as it is very near the flame, its shadow thrown on the street by the rays diverging from the flame is several feet in breadth. If the beak be an inch broad, and situate an inch under the flame, the shadow of the beak on the pavement, under the lamp, will be ten feet broad, if the flame is situate ten feet above the pavement. In some of the new lamps, the reflector placed above the light is made with its concavity so disposed at the edges, that the reflected light is thrown upon that part of the pavement which is under the oil holder. In Major Cochrane's lamps, the oil vessel consists of a bird-cage fountain reservoir, which allows a supply of oil to come down to the wick, when the surface of the oil in which the wick is placed has sunk to a certain point. The wick is double, consisting of two pieces of flat cotton web; between the wicks is a slit through which a current of air ascends to the flame, and on the outside of each wick is another slit; these slits admit currents to the exterior surface of the wicks. Each time that the lamp is trimmed two pieces of wick are inserted, just sufficiently long to last the time that the lamp is required to burn. Naptha distilled from pit coal is burnt in these lamps, and the light is brilliant like the light of coal gas. But the gas lights have the advantage of being unincumbered by the opaque substance of the oil vessel, which intercepts light, and casts a shadow on the street.

The street lamps in London are fixed at the end of iron rods which project from the walls of the houses. The lamp is, over the middle of the foot pavement, ten feet from the ground. There is a row of lamps on each side of the street, the principal street being fifty feet in width. In Paris, where many of the principal thoroughfare streets are not above twenty-five feet in breadth, the lamps are suspended over the middle of the street. A strong rope is made fast to the walls on each side of the street, and to this rope a smaller rope with the lamp is attached. The smaller rope passes over pullies, and comes down into an iron box, where it is fixed on a hook. The iron box is unlocked, and the lamp is let down and lighted with a candle. The light is

Lamps for Lighting Streets || Safety Lamp.

placed before a silver-plated reflector. In Vienna the street lamps are fixed on the upper end of a post. The lamp is taken out of the lantern by means of a pole, and lighted at the foot of the post. This saves the inconvenience which results to passengers from the mode of lighting lamps, by a man with a ladder and torch, as practised in Britain. In most of the towns of Italy the streets are but sparingly lighted. The lamps are fixed at the end of iron rods which project from the walls of the houses. In some of them the light is placed in the focus of a parabolic reflector, or at the meeting of the vertices of two concave conoidal divergent reflectors situated above the light. The French, when masters of Italy, made regulations to improve the lighting of the streets.

In England whale oil is used as the combustible material in the streetlamps; of late naptha, obtained from the distillation of pit coal, has been used in a district of London which is lighted with Major Cochrane's lamps. This naptha is a clear and colourless liquid, and is found to give a good light; it requires to be prepared with particular attention; that made at the gas light work is said to be too easily inflammable. In Paris rape seed oil, and poppy seed oil, are used: these expressed oils are made in the north-eastern part of France and in Flanders. In the south of Europe olive oil of inferior quality and walnut oil are used. Street lamps lighted with the gas distilled from pit coal are now (1821) employed in the principal streets of London, Edinburgh, Glasgow, Liverpool, Manchester, Birmingham, Sheffield, and other cities in Britain. The use of coal gas for giving light had made very little progress in France in 1818, being scarcely employed even in Paris, and we believe not at all at Lyons, although pit coal is abundant and commonly used as fuel there. In 1818, pit coal gas was used for lighting a light-house on the Adriatic in the dominions of the House of Austria near Trieste; the gas being obtained from the coal wrought in the adjacent country.

Safety Lamp.

This lamp was constructed for the purpose of giving light in mines where fire damp prevails. In many of the collieries of Britain, Flanders, and other countries, fire damp, consisting of carburetted hydrogen, issues from different parts of the strata of coal when the coal is worked; and when the fire damp is mixed with a certain proportion of atmospheric air, it explodes by the flame of the miner's candle, burning the workmen severely, and often depriving them of life. Vegetable substances, in the slow decomposition which takes place in them, in the process of putrefaction, give out inflammable gas. This is seen when the leaves of plants fall into water and become putrid, inflammable gas then rises to the surface in bubbles, and is inflamed if a light be applied to the surface of the water. Vegetable matter gives out inflammable gas also in the rapid decomposition occasioned by fire. The flame of vegetable substances consists of the inflammable air resulting from their decomposition, and burning with the addition of the air of the atmosphere. Pit coal consists of the remains of large quantities of vegetable substances, and the fire damp of coal mines may be considered as the produce of the putrefaction which the vegetable matter has undergone, or of some decomposition that the coal is still undergoing. Sir Humphry Davy found that, on breaking some masses of coal under water, inflammable gas was given out. In some places blowers of fire damp issue out at the surface of the earth. A quarter of a mile from Pietra Mala in the Apennines, on the road from Bologna to Florence, there is a blower of inflammable gas issuing from the ground, and proceeding from strata of schistus, and perhaps of coal; Sir H. Davy analysed this gas, and found it to be carburetted hydrogen, like the fire damp of the coal mines. Another blower of the same kind exists on the side of a mountain near the shore of the Gulf of Adalia, in Lycia, on the south coast of Asia Minor. In mines wrought to obtain metals and salt, where there are no strata of vegetable matter like coal, it does not appear that the fire damp occurs.

Safety Lamp.

The merit of that very ingenious and most useful contrivance the *Safety Lamp* is wholly due to Sir Humphry Davy. After having made many experiments for the purpose of forming a lamp to give light in coal mines affected with fire damp, without occasioning explosions which frequently prove fatal to the miners, he found that wire gauze, of which the apertures occupy more space than the cooling or radiating surface of the wire, so as to be permeable to air and light, offered a perfect barrier against explosion; because, although the gas was inflamed within the inclosures formed by the wire gauze, yet the heat being communicated to the numerous surfaces of the wire, the gas on the outside of the wire inclosure was not inflamed. Wire gauze is the best material for safety lamps, as it affords the greatest extent of radiating surface, and by cooling, prevents all explosions that require a temperature higher than the temperature of the atmosphere. An example of the radiating and cooling action of wire is seen in the fire guards of wire, which are hung upon the ribs of fire places in rooms to prevent sparks from being thrown into the room. These fire guards, although they are very near the fire, do not become hot. The apertures of the wire gauze must be smaller, and the wire, which is the radiating and cooling surface, must be in greater quantity; in proportion as the gas in which the lamp is to be used is more inflammable. The fire damp in coal-mines is in almost all cases carburetted hydrogen; and for excluding explosion from a lamp in that gas, it is found that the wire gauze should contain 784 apertures in a square inch.

The wire gauze should be of iron or copper. Fine brass wire is improper, because it is too easily combustible by reason of the zinc it contains. The iron wire should not be tinned, tin being too easily combustible. The body of the lamp should be of copper riveted together, or of massy cast-brass or cast-iron. The screws should fit tight; no aperture, however small, should be suffered to exist in the body of the lamp; and the trimming wire should move through a long tight tube.

The safety lamp is represented in Plate XCIV. fig. 4. A is the cistern containing the oil; B the

Safety Lamp.

brass rim to which the bottom of the wire gauze cylinder is fastened by a screw to prevent it from being separated from the lamp; C is the safe feeder through which oil is poured into the lamp; E the safe trimmer, a wire which passes through a safe tube, for the purpose of raising and trimming the wick; F the wire gauze cylinder. The longitudinal suture where the two edges of the piece of wire gauze that forms the cylinder meet, must be well doubled and fastened with wire. If the cylinder is of twilled wire gauze, the wire should be of iron or copper, at least of the thickness of $\frac{1}{40}$ of an inch; if of plain wire gauze, the diameter should not be less than $\frac{1}{60}$ of an inch. The number of apertures in a square inch should not be less than 784. The wire gauze cylinder F is closed at top by a circular piece of wire gauze, and above this is placed a second top, G, which fits on the cylinder like a cap. In the figure the circular wire gauze top of the wire gauze cylinder is seen at G through the wire gauze of the cap. The circular top of this wire gauze cap is $\frac{3}{4}$ of an inch above the top of the wire gauze cylinder F. I I are thick wires surrounding the wire gauze cylinder, to preserve it from being bent by external force. K is a ring to hang up the lamp, or to hold it by. The most convenient size for the safety lamp is a span, that is, from 8 to 10 inches high, the wire gauze cylinder being 2 to 2½ inches in diameter.

The wire gauze, when choaked with coal-dust, requires to be cleaned by means of a brush, in order to transmit the light.

In figure 4, a lens of glass, L, is placed before the light, sometimes a piece of tin is placed within the cylinder to act as a reflector.

The light of the safety lamp, without a reflector, was found to be nearly equal to the light of a common miner's candle.

Flame produced by the combustion of explosive gases may be extinguished by colder metal. The temperature of metal, even when heated to a white heat, is less than the temperature of flame, and therefore red hot wire gauze in sufficient quantity, and of the proper degree of fineness, will abstract sufficient heat from the flame of carburetted hydrogen or fire damp to extinguish that flame.

Flame, in all cases, is considered to be the combustion of an explosive mixture of inflammable gas and air. If a piece of wire gauze is held over the flame of a lamp, it prevents the flame from passing. The air that passes through is very hot, and is in the state of an explosive mixture, for it will be inflamed if a lighted taper be presented to it. But it is cooled below the exploding point, by passing through the wires, even if the wires are red hot; it is also cooled by being mixed with a considerable quantity of air comparatively cold. The temperature of visible flame is very high, as is seen by the fusion of a small filament of that difficultly fusible metal platinum, which happens when the filament is held in the flame of a candle. A considerable mass of heated metal is required to inflame fire damp. An iron wire of $\frac{1}{20}$ of an inch in diameter, and 8 inches long, red hot, when held perpendicularly in a stream of fire damp, did not inflame it. But wire of the same size, when six inches of it were red hot, and when it was held perpendicularly in a bottle containing an explosive mixture, so that successive portions of the gas were heated by the wire, produced an explosion.

The action of the safety lamp may be exhibited in the chemist's laboratory, by pouring some ether into the bottom of a large jar; the vapour of the ether mixing with the air, produces an explosive atmosphere. When the safety lamp is lighted and placed in the jar, the explosive mixture from the ether will burn within the wire gauze lamp, without inflaming the gas that is without it.

The workman who has only a single gauze lamp, and finds the temperature of the wire increasing rapidly by the fire damp from a blower, can easily diminish the heat by standing between the current and the lamp, that is to say, to the windward of the lamp, or by sheltering the lamp from the current by interposing his clothes; or, by bringing the lamp nearer the orifice from which the fire damp issues, he may extinguish it. There never can be any occasion for the workmen to place the lamp in the exact place, when two currents, one of common atmospheric air, and the other of fire damp, meet each other.

When the fire damp is inflamed in the wire gauze lamp, coal-dust thrown into the gauze cylinder burns with strong flashes, but the explosion is not communicated to the external fire damp by this means.

Phosphorus, sulphur, pyrites, or gunpowder, would produce explosion, by being applied to the outside of the wire gauze cylinder; and sulphur, to produce this effect, must be applied in large quantities, and blown upon by a current of atmospheric air. But there is little danger of these substances being accidentally applied to the safety lamp in mines.

When a wire gauze lamp is made to burn in a very explosive atmosphere at rest, the heat of the wire gauze, when the fire damp is burning within the lamp, soon arrives at its maximum, and then diminishes. The coally matter also, from the decomposition of the oil, choaks the upper apertures of the wire gauze, and thus gradually diminishes the heat by diminishing the quantity of gas consumed. Wire gauze lamps which had been used by workmen for several months, and which had been often red hot in explosive atmospheres, were nevertheless still unimpaired and perfect.

Where the lamp is placed in a current of explosive gas a greater heat is produced, and in this case the radiating or cooling surfaces should be increased. Twilled gauze, or a double or triple fold of wire gauze on one side of the lamp, or a skreen of metal between the lamp and the current, or a semicylinder of glass or mica within, answers the object of preventing the heat from rising to redness.

If the heat of the iron wire gauze rose to that of a strong welding heat, a circumstance which never could happen in a colliery, then the iron wire would burn, and the lamp would be no longer safe.

From a mine of Mr Lambton's there is a violent blower of fire damp conveyed to the surface, upon which the following experiment was made. A brass pipe was fixed upon the blower-tube, so as to make

Safety Lamp. the whole stream of fire damp pass through an aperture of less than half an inch in diameter. The fire damp when inflamed issued from this with great violence and noise, forming a flame of five feet long. This blow-pipe was exposed at right angles to a strong wind. The double gauze lamps soon became red hot at the point of action of the two currents; but the wire did not burn, nor did it communicate explosion. The single gauze lamp did not communicate explosion as long as it was red hot, and slowly moved through the currents; but when it was fixed at the point of the most intense combustion, it reached a welding heat; the iron wire began to burn with sparks, and the explosion then passed.

In other experiments on this blower of fire damp, single wire gauze lamps, with slips of tin-plate on the outside, or in the inside, to prevent the free passage of the current, and double lamps, were exposed to all the circumstances of the blast; but the heat of the wire never approached near the point at which iron wire burns, and the explosion was not communicated. The flame of the fire damp flickered and roared in the lamps, but did not escape without the limits of the wire gauze.

The sparks from a flint and steel mill, a machine which sometimes has been used to give light in mines affected with fire damp, would most probably inflame such a current as the blower above mentioned, because the sparks elicited from steel by the collision of flint, are small portions of the steel in a burning state, as may be seen by collecting these sparks on a sheet of paper, and viewing them with a microscope.

The *lamp without flame*, which is sold as an object of amusement and curiosity, consists of a fine wire of platinum of $\frac{1}{100}$ of an inch in diameter, coiled into a spiral, and placed round the wick of a lamp fed with the spirit of wine, and a little above the wick; when the flame of the lamp is blown out, the heat which the wire has acquired is sufficient to keep up the slow combustion of the vapour of the spirit of wine, and this combustion continues to keep the platinum in an ignited state. The principle of this lamp without flame may be usefully applied to the safety lamp. By hanging some coils of fine wire of platinum above the wick of the lamp, it is believed that the coal miner will be supplied with light in mixtures of fire damp, which, from the small proportion of atmospheric air, are no longer explosive; and should the flame of the lamp be extinguished by the quantity of fire damp, the glow of the incandescent platinum will continue to give light, and the incandescence will cease when the air becomes unrespirable. Sir Humphry Davy found that a spiral wire of platinum, of $\frac{1}{60}$th or $\frac{1}{70}$th of an inch in diameter, suspended within the safety lamp, yields light in a mixture of fire damp with atmospheric air, in which the atmospheric air is in so small a proportion, that the mixture is not explosive. In this situation the heat is not sufficiently great to produce combustion with flame, and combustion without flame takes place. The platinum wire, heated by the flame of the lamp, retains its heat after the flame is extinguished, and this heat is sufficient to occasion a slow combustion or combination of the elements of the fire damp with the oxygen of the atmospheric air; this slow combustion produces sufficient heat to keep the platinum in a state of ignition. Platinum and palladium are the only metals found to produce this effect, because these two metals are of a slow conducting power and capacity for heat. This phenomenon takes place in mixtures of gas where there is common air enough to support the respiration of human beings.

Safety Lamp ‖ Lanarkshire.

At Wallsend and other extensive collieries near Newcastle, in Northumberland, the following regulations respecting the safety lamps are observed. A steady man is employed to take charge of the lamps, and he is responsible for keeping them in good order. A chamber is allotted him, in which he keeps oil, cotton, and spare lamps; the chamber is in a secure part of the mine, as near the workings as possible. The brass collar of the wire gauze cylinder is secured to the bottom of the lamp by a lock, which can be opened only by the lamp keeper; so that the workmen cannot separate the wire gauze cylinder from the bottom of the lamp. After finishing their day's work, the colliers bring the safety lamps to the lamp keeper's cabin. The lamp keeper unlocks the lamps, keeps the bottom, and allows the colliers to take the wire gauze cylinders home for the purpose of cleaning them. When the colliers return to their work next day, the lamp keeper having replenished the lamps with oil and cotton, lights the wicks, screws on the gauze cylinders, and examines them carefully; if any defect appears in the gauze, the lamp is set aside to be repaired. The lamp keeper's business, during the day, is to walk leisurely through amongst the workmen, carrying some spare lamps with him to replace those which happen to be extinguished. (V.)

LANARKSHIRE, or CLYDESDALE, a county in Scotland, situated between 55° 20′ and 55° 56′ north latitude, and 3° 25′ and 4° 22′ west longitude; is bounded on the north by the counties of Dunbarton and Stirling, on the east by those of Edinburgh, Linlithgow, and Peebles, by Dumfries-shire on the south, and the shires of Ayr and Renfrew on the west. In length, from north to south, it is about 47 miles; its greatest breadth, from east to west, is 32, and it extends over 870 square miles, or 556,800 English acres, of which more than a third is fit for cultivation. It is divided into three Wards; the *Upper*, of which Lanark is the chief town, contains about two-thirds of its area, on the east, south, and south-west, the greater part mountainous; the *Middle*, having the town of Hamilton in its centre, stretches along the west and north; and the *Lower*, which contains the city of Glasgow, and a small tract around it.

Situation. Extent. Divisions.

This extensive district presents great variety of surface. Some of the mountains in the Upper Ward, where it is bounded by Dumfries-shire, are about 3000 feet high; and Tinto, on the northern boundary of the hilly district, is nearly 2300. Leadhills, a village on its southern extremity, is 1564 feet above the level of the sea. But in proceeding along the banks of the Clyde, north from Tinto, the face of the country softens down to gentle elevations and depressions, and for 12 miles the river winds slowly

Surface.

Lanarkshire. through beautiful meadows. The Middle Ward is much less elevated, few of the heights being more than 700 feet above sea level; the town of Hamilton is only about 120; yet there are no plains of any extent except along the banks of the Clyde, and a considerable part of the surface is covered with moss, in many places of a great depth. Of the Lower, the greater part is a highly ornamented district, particularly the banks of the Clyde, which are thickly planted with villas, the summer residence of the wealthy inhabitants of the city of Glasgow.

Rivers. The principal river, and, in a commercial point of view, the greatest in Scotland, is the Clyde, from which the county is frequently called *Clydesdale*. It has its rise in the ridge of mountains which separate Lanarkshire from Dumfries-shire, and flowing first north and then north-west, through the middle of the county, falls into the frith of the same name above Greenock, carrying with it the waters collected from 1200 square miles. The principal streams which join it on the south are Duneaton, Douglas, Nethan, Avon, and West Calder, and on the north the Medwin, Mouse, South and North Calders, and Kelvin which separates Lanarkshire from Dunbartonshire. The Clyde is navigable to Glasgow for vessels drawing nine feet of water, and two miles higher for smaller vessels. Most kinds of the fish found in the other rivers of Scotland are also abundant in the Clyde, particularly salmon. The celebrated falls have been described in the *Encyclopædia*, under the article CLYDE.

Minerals. Sandstone and limestone are the prevailing rocks in the lower parts of Lanarkshire, and argillaceous schistus in the high grounds. In the Cathkin hills, near Glasgow, there is a number of basaltic columns, more than 40 feet high, inclined at an angle of about 70°. Ironstone abounds, and is wrought to a great extent at several large establishments. On the southern extremity are the well-known lead mines belonging to the Earl of Hopetoun, from which the village of Leadhills takes its name. In the same quarter gold was discovered in the time of James III., and afterwards collected in considerable quantities. But coal is by far the most important of its mineral treasures. It is supposed to stretch throughout an area of about 70,000 acres, and including the different seams to be about five feet thick. The field near Glasgow contains eight seams, one of them seven feet thick, the whole amounting to upwards of 30 feet. There are several good seams of cannel or candle coal in different parts of the county. This kind has been long used by the lower classes for lighting their houses, and it is known to yield more gas than common coal.

Estates. The valued rent of Lanarkshire is L.162,118, 16s. 10d. Scots; and the real rent of the lands, mines, and quarries, in 1811, was L.298,019, 3s. 1d., and of the houses L. 286,071, 13s. 5d. Sterling. More than three-fourths of the county is the property of great landholders, and almost half the valued rent is divided among estates of upwards of L.1000; but small properties are very numerous, the far greater number being below L.100 of valued rent. These small estates, with many of the class immediately above them, are cultivated by their owners; the large ones are let out to tenants on leases, except the inclosed grass lands, a great part of which is let out from year to year for grazing only. Lanarkshire.

Farms. The arable land is, for the most part, divided into farms of a moderate extent, held on leases for 19 years; but it is not an uncommon practice to let the grazing lands for two or three crops only, for which a high rent is often obtained. In 1798, according to the *Agricultural Survey*, the sheep pastures in the mountain districts yielded a rent of from 6d. to 1s. 6d. the Scots acre, and the arable land in that quarter 8s. In the Middle Ward, the wastes were still less valuable than in the Upper, and its arable land was estimated at 14s. an acre. In the Lower Ward, the average rent was computed to be 25s. It is probable that all these sums may now be nearly doubled. Much of the arable land in the first division is dry and fertile; clay prevails in the second and third; and along the banks of the Clyde there are considerable tracts of an alluvial description.

Climate. As this county slopes to the west almost throughout its whole extent, the Atlantic exerts a powerful influence on its climate. For about two-thirds of the year, the wind blows from the south-west and west; intense frosts are of short duration, and snow seldom lies long in the lower districts; but, from the general humidity of the atmosphere, and also of the soil, seed-time and harvest are often late. In regard to heat, there is a considerable difference between the Upper and Middle Wards, the thermometer on the same day commonly standing several degrees higher in the latter than in the former. Its range is from 11° to 85°. The quantity of rain that falls at Glasgow varies from 19 to 36 inches. Lanarkshire is, therefore, upon the whole, less favourable to the culture of corn than the eastern counties of Scotland.

Dairies. The dairy is accordingly an object of considerable importance here, and is carried on in all its branches. Besides the dairies kept in and near the city of Glasgow, for supplying the inhabitants with milk, cream, and fresh butter, a great number of cows are kept in the Middle and Lower Wards, the milk of which is applied to the making of butter, new milk, and skim milk cheese, and the fatting of calves. The best cheese is similar in quality to the Dunlop cheese of Ayrshire. Clydesdale has been long famous for its draught horses. See AGRICULTURE and DAIRY, in this *Supplement*.

Orchards. Besides the grounds in the environs of Glasgow, from which the city is supplied with small fruits and culinary vegetables, there are considerable orchards in the county. Most of them are on the banks of the Clyde, from the lowest fall to the influx of the South Calder. The trees are chiefly apple, with a mixture of pear, and some plums. About 20 years ago, 300 acres were occupied with orchards, and their extent now is said to be greater. The produce is extremely precarious, but the land, which is for the most part on the steep banks of the river, is of little value for any other purpose. A much larger extent of the banks is occupied by coppice; and throughout the county a considerable space has

Lanarkshire. been allotted to plantations, which consist chiefly of Scots fir and larch.

Inland Navigation

Lanarkshire is traversed by good roads in all directions; and, besides the Clyde, the navigation of which has been much improved by deepening and confining the bed of the river, it has the advantage of possessing an inland navigation, by means of three canals. These are, the *Forth and Clyde Canal*, which enters it on the north, in the parish of Calder, and, after a course of eight miles, passes into Dunbartonshire at the aqueduct over the Kelvin;—at Stockingfield, a collateral branch proceeds to Port Dundas, at Glasgow; the *Monkland Canal*, from the coal-works in the parishes of Monkland, to the Forth and Clyde at Port Dundas; and the *Ardrossan Canal*, which is completed, from Port Eglinton, near Glasgow, to the village of Johnston, a distance of eleven miles, and is intended to be continued to Ardrossan, on the coast of Ayrshire, 22 miles farther.

The city of Glasgow, with its manufactures and commerce, has been described in the articles GLASGOW in the *Encyclopædia* and in this *Supplement*. The other towns are, Lanark, Hamilton, Rutherglen, Biggar, Strathaven, and Kilbride. Lanark, the county town, and a royal burgh, 32 miles south-west of Edinburgh, and 25 south-east of Glasgow, was a place of importance so early as the time of Alexander I. In 1811, the parish contained a population of 5667. Hamilton is situated on the Clyde, 38 miles west of Edinburgh, and 11 south-east of Glasgow, with a population of 5453. In the neighbourhood is the seat of the Duke of Hamilton, and three miles below is Bothwell Bridge, noted for the defeat of the Covenanters, June 22, 1679; see HAMILTON, in the *Encyclopædia* Rutherglen is a royal burgh, on the Clyde, $2\frac{1}{4}$ miles above Glasgow. See this also in the *Encyclopædia*. Biggar is a little market town, on the borders of Peebles-shire, 27 miles south south-west of Edinburgh. Strathaven and Kilbride are small towns near Hamilton; the former has been long noted for its veal. There is a number of villages in the vicinity of Glasgow, which, by their situation, belong to that city, and several of considerable extent, in different parts of the county. Among the latter may be mentioned, Crawford, Carnwath, Airdrie, Douglas, Leadhills, Wilsontown, and New Lanark. At New Lanark, there is the largest establishment for cotton spinning in Scotland. Mr Owen, whose arrangements for the comfort and instruction of his people have been eminently successful, is the principal proprietor. The cotton-manufacture, the iron-works, and the collieries, give employment to the greater part of the inhabitants of Lanarkshire. Every great establishment has a considerable village in the neighbourhood, where the workmen reside.

Representation, &c.

The county of Lanark sends to Parliament one member, who is chosen by about 100 freeholders; and its three royal burghs have a share in the election of two members more; Glasgow and Rutherglen being joined with Renfrew and Dunbarton, and Lanark with Selkirk, Peebles, and Linlithgow. It has one Sheriff-depute, whose jurisdiction extends over all the county, and three substitutes, at Lanark, Glasgow, and Hamilton. Lanarkshire contains 47 parishes, of which 11 belong to the Presbytery of Lanark, 14 to that of Hamilton, and 13 to that of Glasgow, all in the Synod of Glasgow and Ayr; and 9 to the Presbytery of Biggar, in the Synod of Lothian and Tweeddale. The increase of the population has been uncommonly rapid, particularly that of the city of Glasgow. The following tables exhibit an abstract of the census of 1800 and 1811.

See Naismyth's *General View of the Agriculture of Clydesdale*—*Beauties of Scotland*, Vol. III.—The *General Report of Scotland*—and Playfair's *Account of Scotland*, Vol. I. (A.)

1800.*

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
32,259	36,481	1,511	68,100	78,599	15,704	38,086	81,264	146,699

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
32,040	42,510	1,184	88,688	103064	5,387	27,672	9.451	191,752

* In the enumeration of 1800, the parish of Dalserf was not included; the population of which, in 1791, was 1100.

Lancashire.

Situation. LANCASHIRE, a great commercial and manufacturing county in the north-west of England. This district, which is situated between 53° 23′ and 54° 24′ north lat. and between 2° 18′ and 3° 7′ west long. has Cumberland and Westmoreland on the north-east and north, Yorkshire on the east, Cheshire on the south, and the Irish Sea on the west.

Extent. Its extreme length is about 74 miles, and its greatest breadth 44½, but the boundaries being very irregular, its outline is about 342 miles, which comprises an area of 1765 square miles, or 1,129,600 acres. Lancashire forms part of the northern circuit, is situated within the province of York, and diocese of Chester, and divided into 61 parishes.

Divisions. The other divisions are hundreds, of which there are six, namely, Lonsdale on the north, Amounderness, Blackburn, and Leyland in the middle, and Salford and West Derby on the south. Most of these are again popularly subdivided, according to their relative situation, or the names of their towns.

Form and Surface. The greater part of this county, from Rossall Point, on the north, to the Mersey, on the south, except where it is indented by the estuary of the Ribble on the west, lies tolerably compact in the form of an irregular square. To the north of Rossall Point, till it meets the county of Westmoreland, it is very narrow, with a sinuous boundary on all sides; and to the north-east there is a considerable tract called Furness, separated from the rest by extensive sands, where the river Ken, from Westmoreland, discharges itself into the Bay of Morecombe. Opposite the south point of Furness is the island Walney, and other seven, of which the largest is Old Barrow. On the north-east and north much of the surface is occupied with hills and moors, particularly in Furness, where the highest grounds have the name of *Fells;* and also on the east, where it is bounded by Yorkshire; but the south and west quarters spread out for the most part into low and fertile tracts. though not without being interrupted by pretty large fields of moss. Chat-moss, near Worsley, and Pilling-moss, farther to the north, are the most extensive, but many other though smaller tracts occur in various parts. Along the coast there is also a considerable extent of sandy marsh-land, particularly towards the north, near Lancaster and Warton, at the estuaries of the Leven and Duddon, in the north-east or Furness district, and about the banks of the island of Walney.

Climate. The climate of Lancashire is chiefly distinguished for its humidity. According to a register kept at Liverpool from 1784 to 1792, the least quantity of rain yearly was 24½ inches in 1788, and the greatest 54½ in 1792. At Lancaster, in the latter year, the quantity of rain was nearly 66 inches. Four inches have been known to fall in the course of a night. The mean heat at Lancaster, from 1784 to 1790, was 1° 8′. The prevailing winds are from the south, south-west, and north-east. As fogs are not frequent, nor the stagnant waters of any considerable extent, the climate is not insalubrious.

Soils. The soils of this extensive district are necessarily various. The higher grounds, covered with heath and broken with rocks, have a sterile moorish soil; but towards their base, and in the vallies which they form, it is for the most part of the nature of holme. Loam and clay of various degrees of consistence prevail on the flat grounds, with portions of sand, gravel, and moss; and on the banks of the rivers, and at their estuaries, there are large tracts of an alluvial description. The under stratum of the heathy grounds is sandstone or freestone of different colours; a blue rock, popularly called whinstone, is more common in the Fell tracts of Furness. Limestone prevails on the north-west, and towards the eastern boundaries. This and the freestone rock occasionally come in contact with one another in a very remarkable manner, a striking instance of which occurs near the town of Chipping, at the termination of the high ridge of Longridge Fell. In some places towards the eastern border, coal approaches so near the surface, as to constitute the substratum of the soil, and may be seen cropping out at Townley Park, and on the rising grounds on both sides. Marl is frequently found below the soil in the low grounds, and also under the mosses. Much of the vale land consists of rich pastures and meadows; what part of it is under tillage is very productive, and in many instances of a quality to yield turnips and other green crops, as well as grain. A strong clayey loam, however, appears to be the predominant soil throughout the low grounds on the south and west, which, with the wetness of the climate, renders cultivation more difficult and hazardous, than in many other districts.

Minerals. The principal mineral substances are coal, copper, lead, and iron. The first, and in a manufacturing district by far the most important of these, is in great abundance in several parts of the county. The great coal tract commences below Prescot on the south, and, crossing the county in a north-east direction, passes into Yorkshire; but coal abounds farther to the south-east, near Manchester, and also to the north above Lancaster. Its quality, as well as the thickness of the beds, and the depth at which it is wrought, has considerable diversity; but it is chiefly of a bituminous description. Cannel coal is found near Wigan, and at other places, and sometimes in contact with the black coal, or a little mixed with it, as at the pits near Layton-hall. Copper is met with in the rough barren mountains, towards the northern extremity of the high Furness, or Fell district, particularly at Coniston, Muckle Gill, and Hartriggs; but has not been found to the south of Lancaster Sands in such quantities as to be wrought with advantage. Lead occurs towards the north and north-east parts of the county, but in no great quantity. Iron is wrought to the north of Lancaster Sands, in the liberty of Furness. Though found in other quarters, it is not in much abundance, so as to make the working of it profitable. In the northern part of the high Furness tract quarries of blue slate have been opened. Sandstone is wrought in most parts of the county south of the Sands, and limestone, though it is found also in the Furness district, is most abundant on the Lancaster side. The main tracts of this rock are in the northern divisions above Lancaster, and near Chipping and Clitheroe, towards the borders of Yorkshire. More to the

Lancashire.

south, that is, throughout the larger and more valuable portion of the county, it occurs but seldom, and not to a great extent.

Waters.

Lancashire is naturally well supplied with waters, of which its inhabitants have industriously availed themselves in their manufacturing establishments, and in facilitating the transport of their products of all kinds. The principal rivers are the Mersey, the Irwell, the Ribble, and the Loyne or Lune. The Mersey, after receiving the Etherow and the Goyt from Cheshire, and the Tame from Yorkshire, becomes a large river at the town of Stockport, and after a winding course between this county and Cheshire, enters the Irish Sea a little below the town of Liverpool. By means of an artificial cut, it has been made navigable for vessels of 60 or 70 tons from Liverpool to the mouth of the Irwell, up which river the navigation is continued to Manchester.

Irwell.

The Irwell, which has its source among the hilly ranges to the south of Haslingden, also receives several streams, and flowing through a part of Manchester, where it is advantageously employed by the different manufactories especially those of spinning, dyeing, and calico-printing, falls into the Mersey a little below Flixton.

Ribble.

The Ribble is a large river which intersects the county from east to west. It enters Lancashire from Yorkshire, above the town of Clitheroe, and flowing through the beautiful vale of Ribblesdale, joins the Irish Sea a little below the town of Preston, to which it is navigable for small vessels. The Loyne or Lune, also a large river, has its source in the fells of Westmoreland, and comes into Lancashire a little below Kirkby Lonsdale, and passing by the town of Lancaster, afterwards expands into a broad estuary, and empties itself into the Irish Sea. The Alt, the Douglas, the Wyer, the Winster, the Leven, the Crake, and the Dudden, are also considerable streams; and many others, though in a general description not worthy of notice for their size, afford the most important facilities to the manufactories established on their courses. There are several pieces of water in the county, known by the name of lakes, waters, meres, and tarns. Of these the most considerable is Coniston lake, or Thurston water, and Esthwaite water, both in Furness. With these may be mentioned the lake of Windermere, which, though not properly belonging to Lancashire, enters it by its southern point, and forms its boundary for eight or ten miles. Mineral springs have been found at Cartmel, Flukeborough, Wigan, Latham-house, near Ormskirk, and other places.

Of the canals by which a great part of this county is traversed in almost every direction, it would be difficult to give an intelligible description without references to a map, and the limits of this article admit only of noticing them very generally. The great importance of an interior communication by water had been recognized in this quarter a considerable time before any attempt was made to form one entirely artificial. The first object was to render some of the rivers navigable, as in the instance of the Mersey and Irwell, already mentioned, to effect which acts of Parliament were obtained in 1719 and 1720. But the droughts and tides which affect the navigation of these and other rivers, have been found to occasion so much inconvenience, that more recently a preference has been given to channels of communication formed wholly by human labour. The first work of this description in Lancashire, and probably in England, was the Sankey canal, from the Mersey to near St Helen's, which, including its branches, extends nearly twelve miles. It was finished about sixty years ago. Besides this canal, the county is intersected by nine others, four of which communicate with the populous town of Manchester. Of these we can only notice the more considerable. The Duke of Bridgewater's Canal, in so far as it belongs to Lancashire, commences in the suburbs of Manchester, and terminates at Pennington, near the town of Leigh. Under the town of Manchester a portion of it passes into arched tunnels, from one of which coals are hoisted up out of the barges below, through a shaft, and delivered into a large coal-yard in the main street. Before it reaches the coal-works at Worsley, it is carried under ground for three quarters of a mile. The Lancaster canal commences at Kirkby Kendal in Westmoreland, and terminates at West Houghton, to the eastward of Wigan, after a course of 75½ miles. The principal object in executing this great work was to open a ready communication between the coal and limestone districts, and between the port of Lancaster and the populous towns on the north and south. It is on an average seven feet deep, and is navigable by boats of 60 tons burden. The Leeds and Liverpool canal is of still greater length. It extends between the towns of Liverpool and Leeds, along a line of 107¾ miles, and communicating at the latter place with the Aire, which is navigable to the German Ocean, and at the former with the Mersey, which falls into the Irish Sea; the navigation is thus completed between the eastern and western seas. On this canal flats of 42 tons are employed in the coal trade between Leeds and Wigan, and passage-boats are in constant use between these towns. The other canals, though works of great importance when each is considered separately by itself, are much inferior to those we have mentioned.

Landed Property.

A considerable portion of the territory of this county belongs in property to his Majesty, as Duke of Lancaster. The greater part of this consists of what is called *forest lands*, all of which are situated in the most northern parts. It is held in general on leases for thirty years, and yields but an inconsiderable revenue. A few other estates are also of a considerable extent, but, generally speaking, landed property is much subdivided, and hence Lancashire has a greater number of land-owners than any other county in England, Middlesex excepted; many of the estates not affording a rental of L. 200 a year, and not a few being below L. 50.

Agriculture.

Lancashire does not excel in its agriculture. Only about a fourth of its surface is computed to be under corn and other tillage crops, the other three-fourths, subject to a deduction for wastes, roads, &c. being chiefly occupied in grazing and for the purposes of the dairy; and it has been estimated that it does not raise corn sufficient for the support of its population for more than three months in the year.

Lancashire. All the different sorts of corn, however, are cultivated, and where the soil is naturally fertile the crops are often abundant; but turnips and other ameliorating crops are not in general use, nor always, where grown to some extent, properly attended to. Potatoes, however, are cultivated not only upon a large scale but with great care and success; this root, with oatmeal, forming the principal food of the working classes. They were introduced into this county from Ireland, and are said to have been cultivated here long before they had found their way into most other parts of England. Lancashire was long noted for its breed of horned cattle, but a variety of other breeds have been introduced, particularly the Holderness, or short-horned, which are preferred to the Lancashire in the milk dairies near the town, and sometimes also in those at some distance, where the principal object is butter. The native breed is the kind more commonly kept for the cheese dairies, farther into the interior. A cow yields, upon an average throughout the year, from eight to twelve quarts of milk daily, or from four to six pounds of butter in the week, or from three to four hundred weight of cheese in the year. A considerable number of good horses are bred and reared, but its sheep stocks are inconsiderable, and seldom of a valuable description. Farms are in general small, and held either on short leases or without any lease at all, so that a tenant has no encouragement to invest capital in the improvement of the soil.

Manufactures and commerce. This district, however, is greatly distinguished by its manufactures and commerce, which afford employment to three-fourths of its crowded population. Of the former, that of cotton, which is here conducted in all its branches on the most extensive scale, has long been the most considerable. The town of Manchester, where it seems to have had its origin in England, is still its principal seat, though several of the other towns, such as Preston, Garstang, Blackburn, Clitheroe, Middleton, Burnley, Wigan, Bury, Bolton, and Ashton, have a considerable share of it, and, indeed, it is more or less spread over the greater part of the county. (See the articles COTTON MANUFACTURE and ENGLAND in this *Supplement*.) At Ravenhead, near Prescot, plate-glass and mirrors are made to a considerable extent; brass, pewter, and copper works, are carried on at Wigan and at St Helen's; Warrington has manufactures of sail-cloth, linens, and checks, with the making of pins and glass, and iron-founderies; and Rochdale and Ashton furnish a variety of the coarser articles of woollen.

From the great extent and variety of its manufactures, it is natural to infer that its commerce must be upon a scale proportionally extensive, and it is so. Liverpool, as a commercial town, is now perhaps second only to London; and to this rank it has attained from a very low beginning little more than a century ago. In prosperous times, the enterprise of its merchants exchanges the products of British capital and industry with those of almost every climate; and, at all times, it carries on an extensive commerce with America and the West Indies, and with Ireland; to which has been recently added a large share of the East India trade. The ports of Preston, Poulton, Warrington, Ulverston, and Lancaster, the county town, are chiefly employed in the coasting trade.

Labouring Classes. As a considerable portion of the people of Lancashire are employed in working up goods for a foreign market, the condition of the labouring classes, in particular, is much affected by the changes which occur from time to time in that market, and which it is not always possible to anticipate. They are sometimes in the receipt of wages more than sufficient for their comfortable subsistence, and at other times many are thrown out of employment altogether, and the rest retained at wages confessedly inadequate to their support. This is true in an especial manner of its great staple, the cotton manufacture. From this cause, and perhaps also owing to the inconsiderate habits and want of foresight, which such fluctuations are apt to engender, the poor-rates of this county amounted, in 1815, to about L. 400,000, whereas, 40 years before, they were little more than L. 50,000.

Population. According to the census of 1811, the population of Lancashire was 828,309, which, taking its area as before stated at 1765 square miles, gives for every square mile nearly 470 inhabitants. The number of males was 394,104; of females, 434,205. There were 23,305 *families*, chiefly employed in agriculture; 114,522 chiefly employed in trade, manufactures, and handicraft; and the *families* not comprised in these two classes were 24,072.

The returns for Manchester, in 1811, exhibit a population of 98,573; for Liverpool 94,376; and Wigan, Warrington, Oldham, Blackburn, Bolton, Rochdale, Preston, and Lancaster, contained each 10,000 inhabitants and upwards.

Representation. This county sends 14 members to Parliament, two for the shire, and two for each of the towns of Liverpool, Newton, Wigan, Preston, Clitheroe, and Lancaster.

See *Beauties of England and Wales*, Vol. IX., Dickson's *General View of the Agriculture of Lancashire*, 1815; and the article LANCASHIRE in the *Encyclopædia*. (A.)

LANGUAGES.

Languages. In the articles LANGUAGE and PHILOLOGY, of the *Encyclopædia*, a philosophical and critical account of the origin and structure of the most remarkable languages has been given at length, and in detail. The subject will at present be resumed in a point of view more strictly historical, and a classification somewhat more extensive of all the known languages of the ancient world will be attempted; some of the materials being almost necessarily derived from the *Mithridates* of Adelung and Vater, and the publications of Jamieson and of Townsend, together with the criticisms on those works inserted in the *Quarterly Review*.

The study of the affinities of various languages is so far one of the most important of all branches of human knowledge, as it affords, when properly applied, an unerring test of the truth or falsehood of historical evidence, without which it would sometimes be impossible to unravel the mysteries of contradictory testimonies, respecting the relations of the different races of mankind. We have, for example, no traditional evidence in support of any connexion between the ancient Egyptians and the Indians, while, on the other hand, a number of persons, who came with the English army from the East Indies into Egypt, were so strongly impressed with the resemblance of the Egyptian and Indian temples, which appeared even to excite the religious feelings of many of the natives who were among the troops employed, that a very general inclination has arisen from these circumstances, to consider the Egyptian mythology as merely a branch of the Indian. But if the Egyptian people had really been of Indian origin; that is, if the Egyptians and Indians had really been one people, at any later period than that, at which the whole of the Indian and European races were separated from their common stock, the languages of India and of Egypt could not but have exhibited some features of resemblance, which would have preserved the traces of the connexion; while, in fact, there is much less similarity between the Egyptian and the Indian, than between the Indian and the Greek, or the English and the Persian; so that etymology may here be adduced as confirming the evidence, or as justifying the silence, of history; and the resemblance of the mythological representations must be considered as in great measure accidental.

It is, however, only with regard to the languages of the ancient world that we can feel much interest in such an investigation. The American dialects might afford equally extensive subjects of speculation in a metaphysical and critical point of view; but the concerns of barbarians, unconnected and remote from all contact with literature or civilization, and destitute of all historical records, will scarcely be thought to require any great portion of attention from a philosophical inquirer; and there is ample scope for the employment of all our faculties in the analysis and comparison of the various languages of Europe, Asia, and Africa. If, indeed, an extraordinary exertion of enterprise and industry, which can be expected from a few distinguished individuals only in the course of as many centuries, should make known relations, such as Alexander von Humboldt has appeared to discover, between the American and Asiatic nations, a new field would be opened for the gratification of our curiosity; but it can scarcely be expected that these points of resemblance can be sufficiently numerous, to afford any thing like demonstrative evidence, until the whole subject has been much more deeply and repeatedly discussed. In the mean time, a very brief enumeration of the names of the American languages is all that can be required, on an occasion like the present; except the insulated though interesting remark, that the countries separated by Behring's Straits exhibit, as might indeed be expected, strong resemblances, in some of their languages.

Of language in general this essay is not intended to treat, but merely of languages as they are distinct from each other. It is not, however, very easy to say what the definition ought to be that should constitute a separate language; but it seems most natural to call those languages distinct, of which the one cannot be understood by common persons in the habit of speaking the other, so that an interpreter would be required for communication between persons of the respective nations. Still, however, it may remain doubtful whether the Danes and the Swedes could not, in general, understand each other tolerably well, and whether the Scottish Highlanders and the Irish would be able to drink their whisky together without an interpreter; nor is it possible to say, if the twenty ways of pronouncing the sounds, belonging to the Chinese characters, ought or ought not to be considered as so many languages or dialects, though they would render all oral intercourse between the persons so speaking the language actually impracticable. But, whether we call such variations different languages, or different dialects, or merely different pronunciations of the same dialect, it is obvious that they ought all to be noticed in a complete history of languages; and, at the same time, that the languages so nearly allied must stand next to each other in a systematical order; the perfection of which would be, to place the nearest together those languages, in which the number of coincidences in the signification of words, throughout the language, are the most numerous.

It has sometimes been imagined, that all languages in existence present something like a trace of having been deduced from a common origin; and it would be difficult to confute this opinion by very positive evidence, unless every separate language had been very completely analysed and examined by a person

Languages. well acquainted with a variety of other languages, with which it might be compared. But, without such an examination, the opinion must remain conjectural only, and no more admissible as demonstrated, than the opinion of some empirics, that there is only one disease, and that the only remedy for it is brandy. In an essay on probabilities, lately published in the *Philosophical Transactions*, Dr Young has remarked, that "nothing whatever could be inferred, with respect to the relation of two languages, from the coincidence of the sense of any single word in both of them;" that is, supposing the same simple and limited combinations of sounds to occur in both, but to be applied accidentally to the same number of objects, without any common links of connexion; "and that the odds would only be three to one against the agreement of two words; but if three words appeared to be identical, it would be more than ten to one that they must be derived, in both cases, from some parent language, or introduced in some other manner," from a common source; "six words would give near 1700 chances to one, and eight near 100,000; so that, in these last cases, the evidence would be little short of absolute certainty."

The author of the *Review of Mithridates* observes, that, setting out from the establishment of a certain number of separate languages as species, "we may proceed to comprehend, in the description of one *family*, such as have more coincidences with each other than diversities, and to refer to the same *class* such families as exhibit any coincidences at all that are not fortuitous, imitative," that is, from onomatopœia, "or adoptive. In order, however, to avoid too great a number of classes, which would arise from an inadequate comparison of languages imperfectly known, it may be proper, in some cases, to adopt a geographical distinction, as sufficient to define the limits of a class, or to assist in its subdivision into orders. We are thus obliged to employ an arrangement of a mixed nature;" and, in fact, the tests of affinity here proposed depend so much on the progress of our knowledge, in the study of each language, that the results must unavoidably be liable to great uncertainty and fluctuation; so that we can reasonably expect nothing more than an approximation to an arrangement completely methodical.

"If," continues the Reviewer, "the resemblance or identity of a single word, in two languages, supposed to be exempt from the effects of all later intercourse, were to be esteemed a sufficient proof of their having been derived from a common stock, it would follow, that more than half the languages of the universe would exhibit traces of such a connexion, in whatever order we might pursue the comparison. Thus we find in a very great number, and perhaps in a majority of known languages, that the sound of the vowel *a*, with a labial consonant, is employed for the name of *Father;* and if this be supposed to be something like an onomatopœia, or an application of the first sounds which an infant naturally utters, the same reason cannot possibly be assigned for the still more general occurrence of the combination NM in the term *Name*, which is by no means likely to have originated from any natural association of this kind. But neither these points of resemblance, nor any other that can be assigned, are absolutely universal; for besides the numberless varieties referable more or less immediately to *Abba, Father*, we have at least twenty different and independent terms for the same relation in the old world;" *Tia, Issa, Plar, Hair, Rama, Diam, Bina, Kettem, Assainalagi, Medua, Thewes, Sünk, Iot, Anathien, Messee, Indaa, Nu, Nam, Monung, Dengabey, Ray, Tikkob*, and *On;* and about as many for *Name*, besides those languages, in which the version of an abstract term of this kind is less likely to have been ascertained; *Ming, Tren, Diant, Sheu, Hessara, Shem, Tsarship, Ad, Nipta, Lüm, Sacheli, Assia, Wasla, Ngala, Tarra, Sünna, Ran, Hhili, Ding, Dbai*, and *Inghara.* "At the same time, therefore, that we venerate the traces of our common descent from a single pair, wherever they are still perceptible, we must not expect to find them in all existing languages without exception; and an *Etymologicon Universale*, considered as intended to establish such a perfect community of derivation, can only be regarded as a visionary undertaking. Nor must we neglect to unite in some common arrangement of classification, those languages which have the words here specified, or any other radical words, in common, as incomparably more related to each other than the Chinese to the Cantabrian, or the Irish to the Hottentot.

"The gradations, by which a language is likely to vary in a given time, seem to be in some measure dependent on the degree of cultivation of the language and of the civilization of the people employing it. From Homer to the Byzantine historians, the Greek language remained essentially the same for 2000 years; the German has varied but little in 1500; and even the English, notwithstanding its mixture with French and Latin, has altered but three radical words, out of the fifty four which constitute the Lord's Prayer, in the same period. On the other hand, a few barbarians in the neighbourhood of Mount Caucasus and of the Caspian Sea, of modern origin, and ignorant of the art of writing, are divided into more nations speaking peculiar languages, radically different from each other, than the whole of civilized Europe. In such cases, little light can be thrown upon history by etymological researches, while, with regard to more cultivated nations, we obtain, from the examination of their languages, historical evidence of such a nature, as it is scarcely possible for either accident or design to have falsified."

According to the supposition of Professor Adelung, it seems not improbable that Tibet, on the east of Cashmir, may "have been the habitation of Adam immediately after his fall, and the country occupied by the descendants of Cain. In Tibet, and in the countries immediately beyond it, the languages of at least 150 millions of people are still principally MONOSYLLABIC, and from this peculiarity, as well as from the singular simplicity of their structure, they are supposed to constitute the most ancient class of existing languages, though it must be confessed that much of Adelung's reasoning on this subject is extremely inconclusive." Mr Townsend remarks very judiciously, that one of the canons of Rudbeck is by no means admissible. "He states,

that a language, which has numerous monosyllabic expressions, is a parent language. The English has more than 3700 monosyllabic expressions, and the Chinese has none but such; yet neither of them is, for that reason, to be considered as a parent language. Certain it is, that all languages, by abbreviations, have a tendency to become monosyllabic, and therefore a language, which abounds in monosyllables, is ancient, and these commonly are the most antiquated parts of every language. New compounds are incessantly created. These are abbreviated, and in process of time become monosyllabic. In deriving, therefore, a word in one language, from its correspondent expression in some other language, we must ever bear in mind, that, unless in the formation of new compounds, the least abbreviated is commonly the parent, and the most abbreviated its offspring. "Would it be possible for any one to persuade us that *Colaphus* was derived from *Cuff*; or *Blasphemе* from *Blame*?" "A similar instance," says the Reviewer, "might be found in *Trachelos* and *Hals* of the Greeks and Germans; for certainly *Hals* is more like *Trachelos* than like *Collum*."

The Chinese, however, which is the principal, and probably the most ancient of the monosyllabic languages, is distinguished from almost all others by a more marked peculiarity, which is, that its written characters, instead of depicting sounds, are the immediate symbols of the objects or ideas, and are even imperfectly represented by the sounds, whatever difference of accent or tone may be exhibited by the most refined speaker; as indeed it may happen accidentally in our own language, that we may be at a loss to explain, without circumlocution, whether we mean to say *Son* or *Sun*; *Beer* or *Bier*; *Bear* or *Bare*; *You*, *Ewe*, *Yew*, or *U*; but in the Chinese the real cause of this essential characteristic appears to be, that the symbol was in fact originally intended as a hieroglyphic or picture of the object, though the resemblance, coarse as it probably was at first, has been generally altogether lost by the modifications which the character has conventually undergone. And in this point of view the Chinese would require to be classed with the old Egyptian only, since we know of no other language which was habitually expressed in hieroglyphics and their immediate derivatives It is not at all uncommon for the same sound in Coptic, as in Chinese, to have four of five senses all essentially different; as may easily be observed in turning over a dictionary; HOOU, for instance, means *Bad*, and *Them*, and a *Shower*, in two verses of St Matthew, v. 45, 46, and perhaps several other things.

Another ancient and extensive class of languages, united by a greater number of resemblances than can well be altogether accidental, may be denominated the INDOEUROPEAN, comprehending the Indian, the West Asiatic, and almost all the European languages. If we chose to assign a geographical situation to the common parent of this class, we should place it to the south and west of the supposed origin of the human race; leaving the north for our third class, which we can only define as including all the Asiatic and European languages not belonging to the two former; which may be called Atactic, or, perhaps, without much impropriety, TATARIC; and which may be subdivided into five orders, *Sporadic*, *Caucasian*, *Tartarian*, *Siberian*, and *Insular*. The AFRICAN and AMERICAN languages will constitute a fourth and a fifth class, sufficiently distinct from all the rest, but not intended to be considered as any otherwise united among themselves, than by their geographical situation. There is indeed little doubt, that some of the languages here called Tataric are essentially allied to others, which are referred to the Indoeuropean class; but they have been too little investigated, to allow us to make the selection that would be required for completing the classification.

The following tables are copied, with some considerable additions, from the *Quarterly Review*, where they stand as extracted, in great measure, from Adelung's *Mithridates*. The words *Heaven* and *Earth* are chosen as specimens, because they seem to be known in a greater number of languages than any others, except the name of *Father*, which is supposed to exhibit, in some cases, a fallacious similarity. The German orthography has been principally employed, except in such languages as are usually written in the Roman characters, the pronunciation of the consonants being more uniform than in English, and that of the vowels differing little from the Italian.

CLASSES, *Orders*, and Families of LANGUAGES.

I. MONOSYLLABIC.
- 1. Chinese
- 2. Siamese
- 3. Avanese
- 4. Tibetan

II. INDOEUROPEAN.
- 5. Sanscrit
- 6. Median
- 7. Arabian
- 8. Lycian
- 9. Phrygian
- 10. Greek
- 11. German
- 12. Celtic
- 13. Etruscan
- 14. Latin
- 15. Cantabrian
- 16. Sclavic

III. TATARIC
- i. *Sporadic*
  - 17. Tshudish
  - 18. Hungarian
  - 19. Albanian
- ii. *Caucasian*
  - 20. Armenian
  - 21. Georgian
  - 22. Abassan
  - 23. Circassian
  - 24. Ossetish
  - 25. Kistic
  - 26. Lesgian
- iii. *Tartarian*
  - 27. Turcotartarian
  - 28. Mantshuric
  - 29. Tungusic
- iv. *Siberian*
  - 30. Permian
  - 31. Wogulic
  - 32. Ostiak
  - 33. Tsheremissic
  - 34. Morduin
  - 35. Teptjerai
  - 36. Samoiedic
  - 37. Camashic
  - 38. Jeniseiostiak
  - 39. Jukadshiric
  - 40. Koriak
  - 41. Kamtshatkan
- v. *Insular*
  - 42. Kurilee
  - 43. Eastern Islands
  - 44. Japanese
  - 45. Leu Cheu
  - 46. Formosan
  - 47. Philippine
  - 48. New Holland, E
  - 49. Van Diemen's
  - 50. New Caledonian
  - 51. New Zealand
  - 52. Easter Island

IV. AFRICAN

V. AMERICAN

Languages.

FAMILIES, Species, or Distinct Languages, and *Varieties* or *Dialects*, with Specimens.

I. MONOSYLLABIC CLASS.

	Heaven, Sky.	Earth.
1. CHINESE	Tien, Li	Ti, To
Fo Kien	Tshio	Tshiö
Tonquinese	Thien, Bloi	Dat, Diä
Laos	(*Man*, Phu chai)	
2. SIAMESE	Sa wang (*Man*, Pho chai, *Hand*, Mu)	Din
3. AVANESE	Mo kaun, Nip ban	Lu pu, Mić
Peguan	Mo kaun	La pri? Tre
Rukheng	(*Man*, Lu; *Hand*, Lak)	
4. TIBETAN	Nam khei	Dshik ten, Sa

II. INDOEUROPEAN CLASS.

	Heaven, Sky.	Earth.
5. SANSKRIT	Paramandale, Vana, Aagaska, Svarga, Veigunda, Arthaloga, Nibu (*Man*, Purusha	Bumi, Stira
Prakrit	Saggó (*Man*, Pariso)	
Bali	Saggó (*Man*, Burutsa)	
Devanagri	Ardwa, Arthaloga	Buma
Nepal		
Assam		
Tiperah		
Kassai		
Bengalee	Shorgue, Behesht	Porthibit Morto
Hindee		
Urdu		
Brijbassa		
Jypura		
Hindustanee		
Moors	Asmaan, Mukuti	Sjimien, Dshiamin, Dunia
Udaipura		
Benares	Ashaman	Terti
Munipura		
Goandee		
Orissa		
Telug	Paramandal	Bumi, Bumilo
Telinga	(*King*, Raja)	Naela
Carnatic		
Marwa		
Tamul	Wana, Mana, Paramandal	Pumii, Nawarg
Maleiam	Wana (*Bread*, Appam)	
Malabar	Asmanu, Agasha	Bhumi, Samina
Kanara	Weikuntha, Agasha	Pumandala, Puma
Decan	Sorgi	Pirtumir, Soumssar, Zimmin
Kunkuna		
Mahratta	Weikuntham, Suargi, Agasha	Pumandi, Saumsar, Puma
Guzurat	Paramanda	Bumi
Beloshee (Afghan)		
Bikanira		
Sindh		
Multan	Oshman	Dzhemi
Gipsey	Amengi, Tsheros	Pu, Phu, Pube
Wuch		
Sikh		
Cashmir		
Kuch	(1. Katka; 3. Tuhmka; *Man*, Mipa; *Father*, P'ha)	
Maldivian	Ouddou, Uda	Bin
Cingalese	Swärga, Ahasa	Bumidshe, Bumi
Malayan	Surga	Bumi, Dunga, Tana
Sumatran		
Batta	(*Day*, Torangharik)	Tana
Rejang	(*Day*, Bileytueng)	Pihta
Lampuhn	(*Day*, Rannih)	Tanno
Achim	(*Day*, Urai)	Tano
Néas		
Poggy		
Javanese	Surga, Dilangin (*Night*, Malang)	Lemmá, Darat
Borneo		
Andaman	Madamo, (*Head*, Tabai)	Totongnandshi
6. MEDIAN		
Zendish	Tshekhre, Sakhter, Esmené, Sperezé	Za, Zao, Zemo, Zemeno
Pehlvish	Tsherk, Shmeha, Seper	Zivanand, Artu, Damik, Leka, Bamih
Persian	Asmon	Semin, Zemin, Chaki, Chark, Bum
(*Bucharian*)		
Kurdish	Asman, Bauta	Ard, Sigit, Chaak, Chali
Afghan	Asmo, Asman	Smak, Sm'ige, Zmuku
7. ARABIAN		
Syriac	Shemaio	Aro, Areto
Assyrian	Simmi	Dinii
Phenician		
Punic		
Hebrew	Shamaiim	Arez
Chaldee	Shemaia	Ara, Arga
Samaritan	Sumiä	Aroä
Arabic	Semavati	Ardi
Modern Arabic	Ssamvat, Shema, Telek	Arz, Ardh, Auf, Turap, Alem
Maroccan	Smavat	Ord
Ethiopic		
Geez	Samaiat	Mydrni
Tigri		Midre
Amharic	Samai, Sämäie	Mydrm, Medre, Medere
Hausa	Szemmcy	Middrih
Maltese	Sema, Smeviet, Smezijet	Art
8. LYCIAN	(*Son*, Tidaimi; *And*, Atbi)	
9. PHRYGIAN	(*Bread*, Bek; *Water*, Bedü)	
10. GREEK	Ouranos	Ge
Romaic	Ouranos	Ge
11. GERMANIC,	Himina, Himins	Airtha

	Heaven, Sky.	Earth.
Alemannish, 720	Himil	Erdu
Classical German	Himmel	Erde
Transylvanian G.	Hemmel	Jerde
Jewish German	Himal	Hardi
Low Saxon	Himmel, Hemel	Eere, Erde
Frieslandish	Hiemmel	Jerde, Yrtrik
North Friesl.	Hommel	Eerde, Wroll
Dutch	Hemel	Aerde, Eertryke, 1270
Danish	Himmel	Jord
Norwegian	Himmel	Jord, Jera
Orkney	Chimrie	Yurn
Icelandic	Himne	Jord
Swedish	Himil, Himirik	Jord, Jordriki
Dalecarlian	Himblum	Jord
Gothlandish	Hymblum	Tord
Danish Saxon, 880	Heofena	Eortha
English, 1160	Heaven	Eorth, Yearth
12. Celtic		
Irish	Neamh, Nau	Italamh, Thailamh, Talu
Gaelic	Neamh	Talamh, Dtalmhuin
Manks	Niau	Tallu
Walden	Neambh	Talmhin
Cimbric		
Welsh	Nefoedd, Nef	Ddaear
Cornish	Neau, Nev	Nore
Brittanish	Eon, Euff	Duar, Dovar
13. Etruscan	(*Bread*, Puni, Urtu)	
14. Latin	Cœlum	Terra, Tellus
Italian	Cielo	Terra
Piemontese	Siel	Terra
Waldensic P.	Cel	Terra
Genoese	Ze	Terra
Ousernone	Ciel	Terra
Venetian	Zielo	Terra
Friulian	Cil, Ciil	Tiarra
Valais	Cel	Terraz
Bolognese	Cil	Terra
Sicilian	Celu [Quelu	Terra
Sardinian	Cel, Chelo,	Terra
Spanish		
Castilian	Cielo	Tierra
Catalonian	Cel	Terra
Gallician	Ceo	Terra
Portuguese	Ceo	Terra
Romanish	Ciel, Tshiel	Terra
Provençal	Cel	Terra
French	Ciel	Terre
Bearnish	Cèou	Terrŏ
Rovergne	Cel	Terro
Flanders	Ciel	Terre
Walloon	Cir	Ter
Wallachian		
Dacian	Tsheri, Czelurg	Pämentiv
Cutzowallachian	Cerio	Pimchita
15. Cantabrian	Sseru	Lurre
16. Sclavic		
Sclavonian		
Russian Church	Nebesi	Semli
Common Russian	Nebö	Semlä
Malorussian	Nebo	Zemlä
Susdalian	Nebo	Zemlä
Servian		
Uskok	Nebesse	Semli
Ragusan	Nebbu	Semgli
Transylvanian Scl.	Nibe (*Bread*, Liab)	
Croatian	Nebi, Nebiesi	Semlji
South Wendish	Nebi	Semli, Krai
Hungarowendish	Nebi	Semi
Polish	Niebie	Siemie
Kashubish	Nebo	Ziemie
Bohemian	Nebi, Wnebi	Semi
Serbian, Upper Lusatia	Niebiu	Semi
—— Lower Lusatia	Nebu	Semi
Polabish, 1691	Nibis, Nebui	Ssime
Lithuanian		
Old Prussian	Delbes, Dangon	Semie, Worsinny
Prussolithuanian	Debsissa, Danguje	Zemes, Sjemes
Polonolithuanian	Danguose	Ziame, Ziames
Crivingian	Dangus	Zemme
Lettish Proper	Debbes	Semmes, Zemme

III. TATARIC CLASS.

i. Sporadic Order.

	Heaven, Sky.	Earth.
17. Tshudish		
Finnish	Taiwas	Maa
Olonetzish	Taiwag	Ma
Carelish	Taiwag, Taivazh	Mua, Mua
Esthonian	Taewas	Ma
Livonian	Tauwis [Tsiatse	Maal
Laplandish	Almen, Almisin,	Aednemen
18. Hungarian	Menny, Meneg	Fold, Fjeld, Mezon
19. Albanian	Kiel, Kielt	Zee, Sje, Be
Calabroalban.	Chielue	De
Siculoalban.	Chiex	Dee

ii. Caucasian Order.

	Heaven, Sky.	Earth.
20. Armenian	Hierkins, Girkin, Ergink	Hierkri, Gerkrii, Erkir, Tap. Huoch
21. Georgian	Tza, Zata	Sze, Miza, Kwe-
Imirettish	Tshash	Dikha [kara
Mingrelish	(*Bread*, Tshkomi)	Dicha
Suanetish	Tsah	Gim
Tushetic	(*Bread*, Mak)	Jobste
22. Abassan	Agughan, Ashnan	Astula, Tshüllah
Kush Hasib	(*Bread*, Tshakua Makua)	Tula
Alti Kesck	(*Bread*, Mikel)	Tzula
23. Circassian	Wuafä	Tshi, Jacthae
Cabardinish	Phemeh, (*Bread*,	Tshach)

Languages.

	Heaven, Sky.	Earth.
24. Ossetish	Arv, Arwi	Tshigit, Segh,
Dugorish	Arf	Gukh [Stil
25. Kistic	Sigelich, Stuigley	Late, Mezha, Ghumm
26. Lesgian		
Chunsag	Zo, Zob	Ratl
Avaric	Zuv	Bak
Dido	Zub, Zuv	Tshedo
Kasi Kumük	Sur	Kerki
Andi	Teshin	Misa, Bisa, Tshur
Akushan	(*Bread*, Katz,	Mussa, Mussecka
Kubeshan	Zub [Zulhe)	Muza
Kalalatish	Reshin	Unshi

iii. Tartarian Order.

	Heaven, Sky.	Earth.
27. Turcotartarian		
Caspian		
Turkish	Gug, Kiokler, Chiojler	Jer, Gyr, Kher, Ber
Bucharian	Telek, Asman, Kukliar	Zämin, Chak, Jusjurd
Crimean	Gug, Ghiogh, Chok, Kok	Gier
Nogaic	Kuk, Heda	Er, Toprak
Cumanish	Kuk, Kek, Kik	Jer
Kasanish	Kuk, Tengeri, Sa- [moh	Ger, Ars
Mestsheretskic	Kuk	Jer
Bashkiric	Kuk, Ava	Jer, Dzhir
Tobolskic	Auva, Asman	Irjo, Gir, Jir
Kirgishic	Kiuk, Asman	Dzher
Tarary	Auva, Asman	Jir
Tomskic	Kok, Asman	Jer
Turetish	Gkiok, Gioch	Toprak
Tshulimic	Tengri	Jer
Jeniseic	Tengeri	Tobrak, Dzhir
Kuznetic	Tengeri	Jer, Tsher,
Barabish	Asman, Hava	Der [Toprak
Usbek, Chivinic	Asman	Jer, Toprak
Teleutic	Tegir, Tengeri	Cir, Jer, Toprak
Jakutic	Tagara, Chaltan	Sirr, Jeme, Bor
Tshuwashic	Püllu, Pilt, Sunda-	Sir, Ser
Mongol	Tingri [lük	Dere, Gadzar, Shiroi
Burattish	Tingeri	Gazar
Calmuck	Octorgoi	Gasar, Ertjajaze
Tagurian	Tengri	Kaaziar
28. Mantshuric	Abka, Appia	Na
Sagallen	Hurara (*Day*, Jangsey)	Ki?
Corean	Hanel, Tshen	
29. Tungusic	Negdau, Nian, Dshiulbka	Endra, Dunda, Tor
Nertshinic	Tingeri, Nengne, [Nai	Turu
Jeniseic T.	Nengne	Dunda
Mangazeic T.	Nangna	Tukala
Barguzinskic	Nengna	Dunne
Angarian	Nengne	Tukalagda
Jakutic T.	Nengne, Nenone	Dundra
Ochotskic	Nän	Tor
Lamutic	Nana	Tuor
Tshapogiric	Negie	Dunda

iv. Siberian Order.

Languages.

	Heaven, Sky.	Earth.
30. Permian	Olanün, Kümar	Ma, Mu
Sirjänish	Jen esh, Nebus	Mu
Wotiak	Wülün, Küldenjumar, In, Immun, Tslim küd	Musüm, Sioi
31. Wogulic	Eterdarum	Maanku
Tshussovic	Tarom, Nair	Ma
Verchoturic	Numma	Ma
Tsherdymic	Tul	Ma
Berezovan W.	Soum	Mag
32. Ostiak	Nopkon	Jogodt
Berezovan O.	Nomen, Numtorem, Saika	Múg, Mu
Narymic	Nusunde	Mug
Joganic	Ninnäk	Müch
Lumpokolic O.	Num torom	Müch
Vashuganskan	Torom, Jom	Tagai
Tazian	Lom	Tshvotsh
33. Tsheremissic	Kiusiuluste, Küshna juma, Pil, Pil pundash, Joma, Tünja	Ijulmin, Melentesta, Rok, Mlande, Mulens, Zäntiulek
34. Morduin	Mänel, Werepass, Mänen	Mastor, Moda
Moktanic	Shkai	Mastor, Moda
35. Teptjerai		
36. Samojedic		
Archangel	Numilembarti	Jae
Pustozerskan	Nunara	Ja
Oby	Num, Nomün	Joa, Ma, Mogh
Juratshic	Nub	Ja
Mangazeic S.	Podassie	Da
Tawgish	Nuonto, Nuon, Ngoa, Noä	Mamora
Turucanish	Na, Teiga	Ja, Baddu
Tomskic S.	Nom fünde, Lom	Tuetsh
Narymic S.	Tit	Tuetsh
Ketish	Tita	Tuetsh
Timskic	Tit	Tütsh
Caragassic	Tit, Tere	Tütsh, Dsha
37. Camashic	Num, Ti urach	Dsha, Dzhu
Taigish	Numuidi	Dzha
Koibalic	Num	Dshu, Dzhu
Motoric	Orgochairachan, Num	Dsha, Dzha
38. Jeniseiostiak		
Arinic	Oes	Peng
Kotovic	Eish, Eish pa rang	Pang
Assanic	Oesh	Pang
Inbatshic	Es	Bang, Bach
Lumpokolic J.	Etsh	Bing
39. Jukadshiric	Dsjunga, Zjugo, Kundshu	Leviangh, Lewjie
40. Koriac	Kh'igan, Chervol, Chaän, Eiüan, Jau	Nutolüt, Nutelchan
Kolymic	Chaïn	
Tigilic K.	Küsha	Nutelchan
Karaginic	Shilchen	Nintmint
Tshutshic	Keh'quin, Chervol, Chiternik, Killak, Ging, Keilak	Nultenut, Nuna

Languages.	Heaven, Sky.	Earth.
(Greenland and Eskimaux)		Nuna
41. KAMTSHATKAN	Kochan, Hai	Simmt, Nutä
Tigilic K.	Keis	
Srednish	Kochal, Kollaa	Semtüshimta
Joshnyshic	Kogal	Sümmit

v. INSULAR ORDER.

Languages.	Heaven, Sky.	Earth.
42. CURILEE	Niss	Kotan
43. EASTERN ISLANDS	Inkak	Tshekak
44. JAPANESE	Ten	Tsatsmo, Cino, Ci, Tji, Dsi
45. LEU CHEU	Diänni	Zudshi
46. FORMOSAN	Vullum Tounnoun	Nay, Nai
47. PHILIPPINE		
Moluccan	Langua, Surga	Buchit, Dunga
Magindanao	Langit	Lopa
Tagalish	Langit	Lupa, Tana
Bissayish *Sulu*	Langit	Yuta
Bugis	(*Day*, Aso; *Sun*, Mataso)	Tana
Mungharar	(*Day*, Alo; *Sun*, Matalo)	Bûtta
Pelew	Yangley (*Day*, Kokuhk; *Bad*, Mogull)	
Mariana	Languit	Tano
Friendly Isl.	Elandshi (*Food*, Maa)	Tuguta
Cocos Islands	(*Food*, Maa)	Kille
Savu	Liruh	Vorai, Rai
Pampang		Labuad
New Guinea	Bar	Taar, Behoul
New Britain		Nabagr?
Bima	(*Sun*, Mataliro)	Dana
Sumbawa	(*Sun*, Matahari)	Bumi
48. NEW HOLLAND, E.	Kere	Poapoa, Popo
49. VAN DIEMEN'S LAND	(*Father*, Bina)	
50. NEW CALEDONIAN	Ndaoé	Guiahse. Do
51. NEW ZEALAND	(*Bread*, Eei; *Bad*, Kino)	Uenua
Otaheite	Erai (*Food*, Maa; *Bad*, Ino)	Hwennua
Marquesas	Tahua, Hani	Hwenua
Sandwich Isl.	Harani (*Bad*, Ino)	Motu
52. EASTER ISL.	(*Father*, Mama)	Soupe, Henua

IV. AFRICAN CLASS.

Languages.	Heaven, Sky.	Earth.
EGYPTIAN		
Coptic, Memphitic	Phe	Kahi
Sahidic, Thebaic	Pĕ	Kahe, Kah
Bashmuric		
Oasitic	Pē	Kĕhi
BARABRISH	Szemma	Iskitta
KENSY, Burckhardt	Semeyg (*Day*, Ougresk)	Aryd
NOUBA, B.	Sema (*Day*, Aly)	Gourka
BISHAREEN, B.	Otryk (*Day*, Toy)	
Adareb, Salt	(*Day*, Ombe)	Tobút
ARGUBBA	(*Father*, Anathien; *Head*, Dimmaha)	
MASSOWAH	(2, Killot; 3, Szális)	
ARKEEKO, Salt	[illegible]tur (*Sky*), (*Day*, Ummet) (2, Kille; 3. Selass)	Midur
SUAKIN	Tebre	Wuhash
SHIHO, Salt	Aroan	Baru
TAKUE, Salt	(*Man*, Grua; *Water*, Ane)	
BAREA, Salt	(*Man*, Ookooi; *Water*, Umba)	
MUTSHUANA, Salt	(☉, Let chachi, ☽, Werri) See *Beetjuana*	Lehachi
BRIQUA, Salt	(1. Oonchela. 3. Taroo, Miraroo)	
SHANGAILA, Salt		
Darmitchequa	Goza, *Sky* (☉, Woka; ☽, Beja)	Enniah
Tacazze	Quegah, *Sky* (☉, Wah; ☽, Terah)	Hugga
MAKOOA, Salt	(☉, E-zoo-ah; ☽, Mare)	E-la-poo
MONJOU, Salt	(☉, D"yoova; ☽, Mooeize) ["a catch or click]	Mooze
SOWAULI, Salt	(1, Chemo-je; 3 Ma-da-too)	
SOMAULI, Salt	(☉, Ghur-rah; ☽, Tai-ya; 1. K'ow; 3, Sud-de)	
HURRUR, Salt	Semme (☉, Eer; ☽, Werke; 1, Ahad)	Di-che
GALLA	Ivaq (☉, Ad-da; ☽, Dje-á, Ba-te, S.)	Laf-fa, S
ADAIEL, Salt	(☉, Airo, ☽, Alka)	Ba-ro
DANAKIL, Salt	Am-boo re, *Sky*	Arde, Barroo
DUNGOLISH	Szemma (☉, Ayero; ☽, Al-sa, Berra)	Arikha
BORNOU, Burckhardt	Perg,	Tsedy
BORGO, Burckhardt	Sema (*Day*, Dealka)	Berr
DARFUR	Szemma (☉, Dule; ☽, Doal, *Salt*)	Suru, Szura
(AMHARIC) Salt	(☉, Tsai; ☽, Tckerka)	Mider
(TIGRE) Salt	(☉, Tsai; ☽, Werke)	Midre
AGOW, Salt	(☉, Quo-rah; ☽, Er-wah)	Ziv-va
Tsheraz A.	(*King*, Negumani; *Song*, Mossugan)	
Damot A.	(*King*, Negus; *Song*, Mazenà)	
Gafat	(*King*, Negus; *Song*, Aedje)	
Falasha	(☉ Kuara; *Song* Baze)	
SOUDAN	(1, Deja; 3, Oku)	
BEGIRMA	(1, Kidde; 3, Metta)	
FULAH	Hyalla	Lehidy
PHELLATA	Szemma	Lissedi
YALOFS	Assaman	Souffe
BERBER	Ginna, Tigot, Igna (☉, Tafogt)	Doonit, Akal
Canary	Titogan, Ataman (*King*, Monsey)	
Tibbo	(1, Trono; 3, Aguesso)	
Shilluh	(☉, Atfuets)	Berr

	Heaven, Sky.	Earth.
Sivah	(☉, Itfuet)	
Serrbres	Rogue	Lanceh
Serrawallis	(1, Bani; 3, Sicco)	
Mandingo	Santo	Banko, Binku
Yallonka	Margetangala (1, Kidding)	
Sokko	Bandee (1, Kül[illegible])	
Fellups	(1, Enory; 3, Sisajee)	
Timmaney, Winterb.	(1, Pin; 3, Pisaas)	
Bullam	Foy (1, Bul, Nimbul; 3, Rah, Ninraa, Wint.)	Upock, Leh
Susu	Araiani	Bohhe
Fetu	Araiani	Arádde
Kanga	Nesua (1, Aniandu)	
Mangree	Tata (*Head*, Tri)	
Gien	Lam (1, Do)	
Quoja	(*King*, Dondag; *Head*, Hunde)	
Fante	Niame	Assasse
Akripon	Aduankam (1, Ehoo)	
Amina	Jankombum (1, Akkun)	
Akkim	Jahinne (*Head*, Metih)	
Akra	Ngoi, Jankombum?	Sipong
Tambi	Giom (*Father*, Tshinh; *Head*, Ii)	
Whydah	(1, De; 3, Otton)	
Papua	Jiwel (1, Depoo)	
Watje	(1, De; 3, Etong)	
Calbra	(1, Barre; 3, Terre)	
Camacons	(1, Mo; 3, Melella)	
C. Lobo Gonsalvas	(*King*, Sauepongo; *Bad*, Mondello)	
Loango	Iru (1, Boosse; 3, Tattu)	
Congo	Sullo	Toto
Angola	Maulu, Beulu	Boxi, Toto?
Mandongo	Sambiampungo (1, Omma; 3, Metatu)	
Camba	Julo (1, Moski)	
Angola, Hervas	Monte	Aamano
Karabari	Elukwee (1, Otuh)	
Ibo	Tshukko, Ellu (1, Otuh)	
Mokko	Ibanju (1, Kià)	
Wawu	Barriadad (1, Baba)	
Tembu	So (1, Kuddum)	
Krepeer	(*Bread*, Apohae; *Head*, Ota)	
Assianthes	(*Bread*, Abodo, *Head*, Otri)	
Kassenti (Bornu)?	Ktak (1, Obaa)	
Affadeh	Dilko	Ftung
Mobba	Szemma	Barr
Shilluh (Darfur)	(1, Warre; 3, Koddus)	
Darrunga (Gallas)	(1, Kadenda; 3, Attih)	
Shaggai	(*Soldier*, Gonso)	
Madagascar	Danghitsi, Langhitsi Lainch, Atemco	Tane, Tanne, Zanne
Lagoa Bay	(1, Chingea; 3, Trirarou)	
Koossa	Isuhla	Umtsllaha
Beetjuanas	Maaro	Lehaatsi
Mutshuana	(1, Oonchela; 3. Taroo, Miraroo)	Lebochi
South Caffres	(1, Enje; 3, Atatu, Zintate)	

	Heaven, Sky.	Earth.
Hottentots	Inga?	Ki, Kōō, Qu'au Gaukamma
Coranas	(1, T'''köey)	T''kohaub
Saldanha Bay	Homma	Hū
Bosjemans	T''gachuch	T''kanguh

(The Hottentots have three particular clicking sounds, made by withdrawing the tongue from the teeth, the fore part, and the back part of the palate: they are respectively denoted by T', T'', and T''', the two first appear to resemble the sounds sometimes used to express a trifling vexation, and to make a horse go on, or to call to poultry.)

V. AMERICAN CLASS.

i. South American.

	Heaven, Sky.	Earth.
A. Southern Extremity		
1. Terra del Fuego	(A *Penguin*, Compoggre)	
2. Patagonia, Chili		
Moluchan. Araukan	Huenu, (☉, Antu; *Hill*, Calul)	Tue mapu
Tehuelhet	(*Hill*, Cahille)	
Puelche	(*Hill*, Casui)	
B. E. from R. Plata to Marañon		
3. Charrua		
4. Yaro		
5. Bohane		
6. Chana		
7. Minuane		
8. Guenoa		
9. Karigua		
10 Guarany South West North. Tupi, Brasil	Ibag, (☉, Cuaraci; for Ibaca	Ibi
C. E. of Paraguay		
11. Brasilian dialects		
Common	(☉, Arassu, 1, Gipi, 3, Busapu; 4, Busapu munan gipi; 6, Busapu sapu Arndt.)	
Kiriri	Arakie	Bu
Curumare	(*God*, Aunim)	Rada
Forty-nine others unknown.		
D. W. of Paraguay		
12. Aquiteguedichaga		
13. Guato		
14. Ninaquiguila		
15. Guana		
16. Mbaya, Guaikur	Titipi guime	Jigo
17. Payagua		
18. Lenguas		
19. Enimaga		
20. Gulentuse		
21. Yacurure		
22. Machikuy		
23. Mataguaya		
24. Malhalae		
25. Pitilaga		

Languages.	Heaven, Sky.	Earth.
26. Toba	Piguem	Alua
27. Abipon	Ipigem	Aaloa, Aaloba
28. Mocoby	Ipiguem	Aloba
29. Aguilot		
30. Chumipy		
31. Vilela	Laue	Basle
32. Lule	Zo (*God*, Ano)	Ama, A.
E. Coast of Peru		
33. Quichua	Hanacpacha: Hanac? (⊙ Inti)	Caypacha, Cay? [Allpa
34. Aymara	Alapacha, Alai	Acaphan, Aca?
35. Puquina	Hanigo	Cohua [Urakke
36. Yunka Mochika	Angulc	Capuc
F. East of Peru		
37. Samuca	Guiate	Numitic, Nup
38. Chiquitos	Ape	Aaqui, Quiis
39. Moxos	Anamocu	Kiere, Motehi
40. Mobimi	Benrie	Yanlo, Llacamba
41. Cayubabi	Idah	Idatu
42. Itonami	Numane?	Nicosnone?
43 Sapiboconi	Euocuepana	Mechi
44. Heresibocana		
45. Canesiana		
46. Pana		
47. Ikema		
48. Pira		
G. East of Quito, on the Maranon		
49. Aquanos, Aeberos		
50. Mainas	Inapa	Isse
51. Yameos	Arresiuma	Popo
52. Omagua, Yurumagua	Ihuatemai	Tuyuca
53. Yahua; 100 more		
H. From R. Negro to Oronoco		
54. Maipuri	Eno	Peni
55. Salivi	Mume	Ada? Seke?
56. Guaivi, Chricoa		
58. Achagua		
I. About Casanare		
58. Yarura	Ande	Dabu
59. Betoi	Ubu, Tentucu	Umena? Ajno? Dafibu
60. Situfa, Girari		
61 Ottomak	Caga	Poga
62. Guama, Guaneri		
K. North Coast	Cap	
63. Tamanac		Nono
64. Arawac	Aijumün, Kassakku	Wunabu
65. Carib		
Yaoi	Oubecou	Monha
Islands	Capou	Soye
L Mountains in the N. W.	{ Men Women	Nonum Monha
66. Muysca	(⊙ Sua; Man, Muysca)	
67. Kimmzac		
68. Popaya		
69. Darien	(⊙ Nie; Cupego: 3, Pauquah)	

ii. Middle American.

Languages.	Heaven, Sky.	Earth
A. Islands		
1. St Domingo	(*Field*, Conuco; *Meadow*, Savana; *House*, Boa; *Bread*, Casabi)	
B. Darien to Guatimala		
2. Kiche, Utlateca		
3. Poconchic	Taxah (⊙, Quih, *Head*, Na; *Hand*, Cam, *Bad*, Tsêri)	Acal, Vleu
4. Yucatan, Maya, Caanné	(⊙, Kin; *Hand*, Cab)	Luam
C. Table Land of Mexico		
5. Mixtecan	Andihui, Andi	Ñuuñaihui Ñuñai
6. Totonacan	Tiayan, Acapon, Acapaian (1, Tom; 3, Toto)	Nitiet?
7. Mexican, Aztekan	Ilhuicatl (⊙, Tonatiuh; 1, Ce; 3, Yei)	Tlalli
8. Huastecan	Tiaeb (⊙, Aquicha; *Head*, Na)	Tzabal
9. Othomi	Mahêtzi	Chimohòi, Hoy
10. Mechoacan		
11. Pirindan	Pininte	
12. Tarascan	Avandaro (1, Ma; 3, Tanimo)	
D. California to Ri del Norte		
13 Coran	Tahapoa	Chuèhti
14. Tepehuana, Topia		
15. Tubar	Tegmeccarichui	Nuniguatae
16. Tarahumaran	Guami? (*Bad*, Iseti, *Dog*, Cocotshi)	Guè
17. Zuaquan, Yaqui	Tevecapo	Buyapo
18. Pima	Titauacatum? (*1*, Ani; 1, Mato; 3. Waik)	Inatuburch?
19. Eudeve	Tevictze?	Yuhtepatz,
20. Opata	Tequiaca?	Terepa?

iii. North American.

A. N.W. of New Mexico		
1. Jetan, Apache		
2. Keres, Moqui		
B. About California		
3. Pericu		
4. Waicuric	Tekericadatemba (⊙, Ibo, Ibunga; ☽, Gomma, Ganehma)	Datemba
5. Cochimi, Laymon	Ambayujui, Ambeing	Keammetè, Amet, Ametetenang

Languages.	Heaven, Sky.	Earth.
C. N. of California		
6. St Barbara	(*Head*, Nucchù; 1, Pacà; 3, Mapja)	
7. Eslene	Imita (⊙, Tomanis ashi; 1, Pek; 3, Julep)	
8. Runsien	Terray (⊙, Orpetuei istmen; 1, Enjala; 3, Kappes)	
9. Achastlien	(1, Moukola; 3, Capes)	
10. Ecclemach	(1, Pak: 3, Ullef)	
D. About Nootka		
11. Nootka Sound	Nas, Inaihl nas (⊙, Opulsthl; 1, Tsawak; 3, Catsa)	
12. Atnah	(*Water*, Shaweliquoih, *Head*, Scapacay)	
13. Friendly Village	(*Water*, Ulkan; *Fire*, Neach)	
14. Queen Charlotte's Isl.	(*Fire*, Tesh; 1. Sounchou; 3. Slōōnis)	
15. Colushan	Ki, Keu, Kiiwa, Kitani, Kügon, Chaaz	Tljaknak, Tlatka, Tlekw, Tka, Shü, Tlinkitaannü
	(*Stone*, Te; Mex. Tetl)	
16. Ugaljachmuzi	Koas (*Throat*, Katkatl; Mex. Cocotl. "*Boil*, Coatk; Mex. Coxitia")	
17. Tshinkitany	(⊙, Krane; 1. Clerg, Kaikc; 3. Notshk, Netx)	
18. Kinaizi	Jujan, Juon, Jugan	An, Altnen, Alslen
E. W. of Mississippi		
19. Blackfooted Indian	(1, Tokes-cum; 3, Nohokes-cum)	
Blood Indian, Pegan		
20. Tall Indian	(1, Karci; 3, Narce; 4, Nean)	
21. Sussee	(1, Ut-te-gar; 3, Taukey; 4, Tobo)	
22. Snake I.		
23. Nadowessian	Uohta tibi (⊙, Paetà; ☽, Oweeh)	
Assinopoetuc Sioux	(*Dog*; Shong; 4, Tope)	
24. Saki, Ottogami Menomene		
25. Osage	(*Wind*, Tattasuggy; [*Brothers*, Tinaitauna?])	
Winnibeg, Maha		
Missouri, Oto		
Arkansa, Kanze		
26. Pani		
27. Caddo, Natshitotshe		
28. Adaize, hapa		
F. W. of Mississippi, to Ohio		
29. Floridan, Apalache	(*Agreeable*; Hitanachi; *Priests*; Jaoiia)	
30. Timuacan	(*My*, Na; *Elder Brother*, Niha; 1, Minecotamano; 3, Nahapumima)	

Languages.	Heaven, Sky.	Earth.
31. Natshes	(⊙, Oua chill)	
32. Muskohge, Creek	(⊙, Hashsch, Husà; 1, Hommai, 3. Tootshēna)	Ecaunnauh
33. Chikkasaw, Choktaw	(⊙, Hashe, Hasce; 1, Chephpha; 3, Tootshēna)	Yahkanè
34. Cherokee	(⊙, Eusse, Anantoge calesta; *Fire*, Cheela; 1, Soquo)	
35. Woccon	(⊙, ☽, Witapare; *Water*, Eau; 1, Tonne; 3, Nammee)	
36. Katahba	(⊙, ☽, Nooteeh; *Water*, Ejau)	
*37. Six Nations	Karongiage, Caurounkyawga, Kaaronhiate, Toendi	Oo-hon-cha, Ouhoncheat, Ahunga, Ohunjea, Uehwuntskia, Ondeehra
Mohawk	(*Fire*, Ocheelch)	
Seneka		
Onondago	(*Dog*, Chierha)	
Oneida		
Cayuga		
Tuscarora	(☽, Hatshe-nyahah; *Water*, Auweau; *Dog*, Cheeth)	
G. W. of Hudson's Bay, and S. W.		
38. Chippeway of Del.	(*Tooth*, Tibbit, Wibit; 3, Taghee; 4, Neon, Nea)	
39. Delaware	(*Tooth*, Weepeet)	
40. Algonkin Mohegan	(*Tooth*, Tibit; 4, Neou)	
41. Shawanno *Pamptícough*	Spimiki (*Tooth*, Nepittalleh)	Assiskie
42. Miami, Illinois	Keehekoue (⊙, ☽, Kilswoa; *Tooth*, Neepeetah)	Akihkeoue
43. Kikkapoo	(⊙, ☽, Kishessu)	
44. Piankashaw		
45. Pottawatameh	(*Tooth*, Webit)	
46. Delaware	Acoossagame (*Tooth*, Weepeet)	Achquidhackamicke, Agi, Hogkey
47. Minsi	(*Tooth*, Wichpit)	
48. Sankikani	(*Tooth*, Wypyt)	
49. New Sweden	"Hocque" (*Flesh*, Jos)	[Hocque
50. Narraganset	Keesuck (3, Nish)	Aucke
Natik	Kesuk (3, Nishnoh)	Ohke
51. New England	(*Tooth*, Mepeteis; 3, Nis)	
52. Abenagui		
53. Mohegan	Spummuck (*Tooth*, Weepeetan)	Hacki, Nohmkey
54. Penobscot	(*Tooth*, Weebeetah)	
55. Souriquois	Ouajek (⊙, Kissis; *Tooth*, Nebidic)	Megamingo
56. Micmic	Ouiok	
57. E. Chippeway	Speminkakuin	Aukuin
58. Messisauger	(⊙, Keeshoo)	Nindohockee
59. N. Algonkin	Spiminkakuin	Ackouin, Acke

Languages.

	Heaven, Sky.	Earth.
60. Knistenaux	(⊙, Pism; *Head*, Us-ti-quoin; 4, Neway)	Messe asky
61. Nehetawa	(4, Naou)	
62. Skoffie	(*Head*, Mestichee)	
63. Mountanae	(*Head*, Teekecbee)	
64. W. Chepewyan Mack.	(⊙, ☽, Sah; *Head*, Ed-thie)	
65. Nagail	(*Head*, Thie)	
66. Hudson's Bay Islands	(*Head*, Tenet thie)	
H. North Coasts		
67. Greenland	Killang, Kilak (⊙, Ajut, Seckanach; ☽, Anningat; 1, Attauseck; 3, Pingasut)	Nuna
68. Eskimaux	Taktuck, Nabugakshe (⊙, Sukkinuch, ☽, Tatcock)	
69. Tshugassic	Koilak	Nuna
70. Norton Sound	(*Hand*, Aishet; 1, Adowjack; 3, Pingashook)	
(71.) Tshuktshe	Keilak	Nuna
71. Jakutat	Kilag	Nuna
72. Konage, Kadjak, I. or Kikhtak	Killach (*Hand*, Aiget; 1, Alchallack; 3, Pingaic)	Nuna

These tables will at least serve, notwithstanding some imperfections and uncertainties, as a convenient synopsis for facilitating the reference to a brief sketch of the history of the different families of languages.

1. The strongest proof of the great antiquity of the Chinese language appears to be the great simplicity of its structure, and the want of those abbreviations and conventional implications which have been sometimes called the wings of languages. It is natural that, in attempting to express ideas at once by characters, the rude pictures of material objects should first have been principally, if not exclusively traced; thus the Egyptians had ⊙, ☽ for the *sun* and *moon*, and for a country or *field*, and the Chinese have still 日 月, 田 for these objects respectively, the characters having been made square instead of round, which some of them were in their more ancient forms. The Egyptians represented a *man* by a figure kneeling, and stretching out his hand, or in the enchorial character, thus . (See the article Egypt, Pl. LXXV. n. 73.) The Chinese figure may originally have been of the same form, but at present is more like a pair of legs only, 人, while a *dog* seems to have three or four legs; 犭, or 犬. A thousand, according to Mr Jomard's ingenious conjecture, was copied from the lotus, with its seed vessel, having a great multitude of seeds, and the Chinese 千 is certainly not altogether unlike the Egyptian (n. 202), nor is the character for light 光, which seems intended to represent a radiant body, altogether different from the or so often found among the hieroglyphics of Egypt, although it is not easy to believe, with Mr Palin, that the manuscripts found with the mummies agree precisely with a Chinese version of the Psalms of David, character for character. The successive introduction of figurative expressions and characters may easily be imagined, but it would be useless to enter at present into further details of this kind on grounds almost entirely speculative. The Chinese are said to have been, in the ninth century, a race of people resembling the Arabs; their physiognomy was contaminated, in the thirteenth and fourteenth, by a mixture with their conquerors, the Mongols; but their language remained unaltered. The dialect of *Tonkin* is sometimes called the language of *Anam*, and the *Guan*; on occasions of state they use the Chinese character, but more commonly a character of their own, probably resembling that of the Siamese. Dr Leyden observes, that at least twenty different nations employ the Chinese characters, though they read them quite differently; and he considers the Cochinchinese, the Cantonese, and the Japanese, as all essentially different from the Mandarin Chinese, though they have all some words in common. He gives us, as the names of the dialects of Chinese, constituting almost as many separate languages, 1, *Kong*, spoken at Canton; 2, *Way*; 3, *Nâm*; 4, *Chéw*; 5, *Síw*; 6, *Lüi*; 7, *Limm*; 8, *Khum*, or Mandarin; 9, *Síu*, 10, *Kunng*; 11, *Hyong sar*, spoken at *Macao*; 12, *Sun tahk*, 13, *Nam kói*; 14, *Pún ngi*; 15, *Tòng khún*; 16, *Fo khun*; or *Chinchow*. There is also a language spoken by the *Quan tô*, between Tonkin and China, a people who consider themselves as more ancient than their neighbours. Notwithstanding, however, all this supposed diversity, we may trace a considerable resemblance in the spoken language, even as far as Corea. In all these dialects, the conversation is a sort of recitative, and the different notes give distinct meanings to the words; as, in fact, we distinguish in English the sense of M? from M! or simply M.; tones perfectly understood, though never written. The Chinese are without the sound of the letter *r*, and several other sounds common in Europe; the only way in which they express foreign words is, by putting together the characters of the nearest import, with a symbol of pronunciation annexed to them; thus, for *Christus* and *Cardinalis* they are obliged to write *Ki lu su tu su* and *Kia ul fi na li su*, with a mouth annexed to them. The names of places are generally distinguished by a square inclosing the characters which express them, and the names of men, in some books, by a line drawn on one side of the characters only. In this there seems to be a distant analogy to the ring which incloses proper names in the Egyptian inscriptions, but the names of places were not distinguished in this manner by the Egyptians. The dialects of Cambodia and Laos have received some mixture of Malayan from their neighbours;

Languages. in writing the former of these, sometimes called *Khôhmen*, according to Dr Leyden, the Bali, or old Sanscrit character, is employed; and the latter has some analogy with the Siamese; indeed, both the Siamese and the Avanese are disposed to derive themselves from Laos. It may be seen, from the specimens exhibited in the article PHILOLOGY of the *Encyclopædia*, b. 125, that at least some of the Chinese dialects have sounds agreeing in several instances with European words of the same import; but the agreement is scarcely precise enough to justify our inferring from it an original connexion between the languages.

2. The language of SIAM resembles the Chinese in its simplicity and metaphorical structure, though not so decidedly monosyllabic. It is obvious, however, that the distinction of monosyllabic and polysyllabic could not, in very ancient times, have been so positively laid down as at present, since it was usual, in almost all countries, to write the words contiguous to each other, in a continued series, without any divisions between them; and, even in modern printing, there is a happy invention, which often restores this agreeable obscurity, under the name of a hyphen, by the use of which we avoid the difficulty of determining whether we wish to employ one word or several. The Siamese call themselves *T'hay;* and a part of their country is distinguished by the appellation Tai hai, or Great T'hay. The numerals resemble the Mandarin Chinese; several words of the language are borrowed from the Bali; it is written in an alphabetical character, which is said to be complicated and refined.

3. The AVANESE or *Burmanish* has also borrowed some polysyllabic words from the Bali, and is written in a peculiar alphabetical character. It must be considered as an era in the history of this country that its Emperor has employed Mr Felix Carey, at his own expense, to establish a printing press at Ava, his metropolis, for printing a translation of the Scriptures in Burmanish. A dialect, spoken in the district called Tanengrari, is said to be of greater antiquity. The *Môn* or *Peguan* is called by Dr Leyden a distinct original language; but it is written in the Avanese character, and Adelung's specimen scarcely differs at all from the Burmanish. The language of Arakan and Rashaan is called *Rukheng;* it contains a number of words from the Bali, many of them converted into monosyllables by an imperfect pronunciation. Dr Leyden considers it as the connecting link between the monosyllabic and the polysyllabic languages, and he calls it an original language, notwithstanding its acknowledged derivation from its neighbours. It employs the Devanagri alphabet, including the letter R. Out of 50 words of Rukheng, quoted by Buchanan, the seven which are not Burman are only varieties of pronunciation. The *Kiayn* or *Kol'* and the *Kukis*, northeast of Chatigong, are mentioned as neighbouring tribes, speaking languages almost entirely different from the Rukheng. We find, in Mr Buchanan's paper, some specimens of the languages of the Burma empire, which it is difficult to distribute methodically, without a further knowledge of their peculiar characters, but some of which may, without impropriety, be introduced here. Languages.

		Earth.
Myammaw, in Burma	(*Head*, Kaung; *Wind*, Lae)	Myaegee
Yakain, in Arakan	(*Wind*, Lee)	
Tanaynthoree		
Yo	(*Stone*, Klonkag)	
Moitag, near Assam	(*Head*, Kop, Kok; ⊙, Noomeet)	Leipauk
Koloun, or *Kiayn*	(*Head*, Multoo; ⊙, Konec)	Dag
Kurayu or Kaloon		
Passooko	(*Head*, Kozohui; ⊙, Moomag)	Katchaykoo
Maploo	(*Head*, Kohuin, ⊙, Moo)	Kolanghoo
Play	(*Head*, Kohui, Pokochui ⊙, Mooi, Moomag)	Kako, Laukoo
Hindu of Burma		
Rooinga	(*Head*, Mata, ⊙, Bel)	Kool
Rossawn, Arakan	(*Head*, Mustok; ⊙, Sooja)	Murtiha
Banga, or *Ayhoba*	(*Head*, Teekgo; ⊙, Bayllee)	Matee

4. The language of TIBET, or the Tangutish, has some words in common with the Chinese, but is less simple in its structure. It is at least as ancient as the religion of the country, which is nearly coeval with Christianity. Its character is well known to be alphabetical, from the title of the learned work of *Father Georgi* on the subject.

5. The *Indoeuropean* languages have been referred to a single class, because every one of them has too great a number of coincidences with some of the others, to be considered as merely accidental, and many of them in terms relating to objects of such a nature, that they must necessarily have been, in both of the languages compared, rather original than adoptive. The SANSCRIT, which is confessedly the parent language of India, may easily be shown to be intimately connected with the Greek, the Latin and the German, although it is a great exaggeration to assert any thing like its complete identity with either of these languages. Thus we find, within the compass of the Lord's Prayer only, *Pida, Pitir*, among the Sanscrit terms for *Father*, Gr. *Pater*; *Nama*, or *Namadheya* for *Name*, Gr *Onoma, Onomati; Radshiam, Kingdom*, Lat. *Regnum* from *Rego*, *Manasam, Will*, like the Greek *Menuo*, and the Latin *Mens; Stira, Earth*, Gr. *Era*, whence perhaps the Latin *Terra;* and *Danim*, or Devanagri *Dia*, Day, Lat. Dies. There are also some singular resemblances of declension and conjugation between the Sanscrit and the Greek, as *Dodami, Dodasti, Dodati;* in old Greek *Didomi, Didosi, Didoti*. In a tablet of the date 23 B. C. we find *Kritico* for a *Judge*, Gr. Crites, Criticos. In Mr Townsend's work we also find some well selected instances of resemblance between the Sanscrit and other languages; thus *Bhru*, is *Brow; Pota*, a *Boat; Bad*, a *Bath;* Germ. *Bad; Dhara, Terra; Nava, Novus; Nakta, Nocte, Night; Pad, Foot, Patte;*

 Prathama or *Protoma, first*, whence we may deduce both the Greek *protos*, and the Latin *primus*; and *Upadesaca, Didasco, Doceo*, and *Disco*. We have also *Vayajan, wind*, in Russian *Vieyanie;* and *Vidhava, widow*, Latin, *Vidua*, German, *Wittwe*, Russian, *Vdova*. The *nt* of the plural verb is found in the Sanscrit *Bhavanti, they are, Dadanti, they give*. Sir William Jones and many others have attributed to some of the works, which are still extant in Sanscrit, an antiquity of four or five thousand years; but Professor Adelung denies the validity of any of the arguments, which have been adduced, in favour of a date at all approaching to this.

The Sanscrit, even in its earliest state, can scarcely have been altogether uniform throughout all the countries in which it was spoken, and it has degenerated by degrees into a great diversity of modern dialects: the term signifies learned, or polished. Beyond the Ganges, it is called *Bali* or *Magudha*, which the missionaries say "scarcely" differs from Sanscrit; the term Magudha is said to mean mixed or irregular. In Siam the Sanscrit is still the language of elegant literature; and it is often employed throughout India, with some little difference of construction, under the name of *Devanagara*, the divine language. The *Prakrit* is rather a vague term, meaning, according to Mr Colebrooke, common or vulgar, but it is also applied to the language of the sacred books of the "Jainas." We find in a little publication, entitled, a *Brief View of the Baptist Missions and Translations*, some useful information respecting the Indian languages and dialects, into a great number of which these laborious and disinterested persons have made or procured translations of the whole of the Scriptures, which they have printed at Serampore near Calcutta. The dialects, which they enumerate, are principally arranged in a geographical order; and beginning with those which are spoken towards the middle of India, as the pure *Sanscrit* and its least modified dialects, we may place next to them the languages of the countries bordering on the monosyllabic nations, towards the North and East; we have here the dialects of *Nepal, Assam*, or *Uhumiya, Tipcrah*, and *Kassai*, of which little more is known than that translations into the first two have been already executed: the *Bengalee* is spoken in and about Calcutta: the *Hindee* or *Hinduwee* is spoken about Agra; it is printed in the Devanagri character, the font of which contains more than 800 varieties of letters and their combinations; the *Urdu* or *Oordoo* is a subdialect of the Hindee, as well as the *Brijbassa*, which is nearer to the Sanscrit than some other dialects: the *Jypura* is mentioned as another language, belonging to the same neighbourhood: the *Hindustanee* is spoken in Hindustan Proper, or Lower Hindustan; the missionaries say it is "*diametrically* different" from the Hindee: the *Moors* or "Mongol Indostanish" seems to belong to this country, being mixed with a good deal of Persian and Arabic, unless it be rather referable to the Hindee: the dialects of *Udaipura, Benares*, and *Munipura*, are also called separate languages: the *Goandee* is spoken at Nagpore, in the Mahratta country: further east is *Orissa* or *Uriya*, the language of which is printed in a character requiring 300 different types: the *Telug* or *Warug* is spoken about Cuddalore and Madras: the *Telinga* further west: the *Carnatic* has a peculiar language, besides the *Tamul*, which is spoken from Paleacate, near Madras, to Cape Comorin, and the *Marwa*, which appears to belong to a part of this country. About Cochin in Travancore we have the *Maleiam*: further north the languages of *Malabar, Kanara*, and of the *Decan;* the dialect of Malabar is of considerable antiquity, being found in two copper tablets as old as the eighth or ninth century; then comes the *Konkuna*, about Bombay: the *Mahratta* is further inland: the *Guzurat* on the coast: and beyond the Indus the *Beloshee* in Belochistan: north of this we find the *Afghan* or *Pushtu* language, which contains more Hebrew words than any of its neighbours; the people are said to have come from the north, about 2000 years ago, and, according to a Persian tradition, to be descended from King Saul: indeed, the language stands somewhat more correctly under the Median family in the *Mithridates*, but since it forms the connecting link between the two families, it might perhaps be as conveniently arranged among the more numerous species of the Sanscrit; it is written in the Arabic character, with some additional letters for expressing the Sanscrit sounds. The language of *Multan*, north of Sindh, has about one tenth of Persian mixed with it. The *Gipsies* were certainly expelled from some part of India by the cruelties of Timur Leng, about 1400; and they were probably some of the *Zingans*, in the neighbourhood of Multan; their language having a great number of coincidences with that of Multan, and being still more manifestly a dialect of the Sanscrit, although they have adopted many European, and especially Sclavonian words. When they first appeared in Europe, they were supposed to amount to about half a million; at present they are less numerous.

The *Maldivian* is peculiar to the group of small islands from which it is named; the Baptists have already printed some books in it. The people are said greatly to resemble those of Ceylon. The *Cingalese*, which is spoken in great part of Ceylon, is a mixture of several of the continental dialects; and it has been observed that the proper names in Ceylon mentioned by Ptolemy are of Sanscrit origin. Dr Leyden gives as a proof of the antiquity of the *Malayan*, that the *Temala* of Ptolemy is derived from *Tema*, tin. The connexion of this language with the Sanscrit has not been very universally admitted; and some of those who have studied it most are disposed to consider it as wholly original; but in the purest part of the language, Dr Leyden confesses that there is a considerable resemblance to the Javanese and the Siamese; the words derived from the Sanscrit he considers as somewhat less numerous amounting however to about 5000, they are generally less like the Bali than the Sanscrit, and a still smaller number are borrowed from the Arabic. The character of the monosyllabic languages is in some measure retained. Sir William Jones considered the Malayan as a derivative of the Sanscrit; Mr Marsden supposes it to have received its Sanscrit words through Guzurat; Dr Leyden rather from Ka-

linga or Telinga; and it exhibits some traces of the dialects of Tamul and Maleialam. Besides these various sources, it is said to have borrowed some of its simplest words from the Javanese and the Bûgis; and it has become more nearly monosyllabic by dropping the first syllables off some of the words which it has adopted. The *Javanese* is said to be more ancient than the Malayan; the empire of Java was formerly powerful and flourishing: the ancient language was much like the Sanscrit, more so than the Malayan, but was written in a peculiar character. Dialects of this language are still spoken in Bali and in Madura. Leyden thinks the Malays were derived from Java; Marsden rather from Sumatra: though he allows that there are some reasons for conjecturing that an old Sanscrit colony may have settled many hundred years ago in Java, and mixed its language with a supposed mother tongue of that Asiatic race.

Of the *Sumatran* dialects, the principal, according to Dr Leyden, is the *Batta*, spoken by a people who occupy the centre of the island, and who still, like some other Indian nations, retain the custom of eating their old relations. The language seems to be partly original, and partly connected with the Malayan, and other dialects of the neighbouring islands. The *Rejang* is chiefly a mixture of Batta and Malayan; in the *Lampuhn* or Lampung, there is also some Javanese. The *Achi* has admitted a still further influx of words belonging to all the Mussulman jargons of the neighbourhood, especially to that of the Mapulas of Malabar. There are other dialects of less note in Néas and the Puggy Islands, most resembling the Batta. This language is provided with a peculiar alphabet, which is remarkable for being written from the bottom of the paper upwards, like the Mexican hieroglyphics: though the Battas, as well as the Chinese, sometimes hold their books so as to read horizontally. In Borneo there appear to be several dialects, or rather separate languages, two of them, according to Dr Leyden, are the Biaju and the Tirun. The *Andaman* language is inserted here for want of a better place only, it does not appear to have any connexion with the Sanscrit, and may possibly be found to be more like that of Madagascar: the people seem to belong to the Papuas, a distinct original race, according to Dr Leyden, black, and with woolly hair.

Besides the numerous translations into languages of the Indoeuropean class, the Baptist Missionaries have also printed some Armenian and Persian works at the indefatigable press of Serampore, which is supplied by a letter foundery and a paper mill, belonging to the same establishment, enabling them to execute the whole business at less than half the expense of European books of the same magnitude. The little pamphlet, already quoted, contains also specimens of the characters of the Sanscrit, Assam, Bengalee, Mahratta, Sikh, and Cashmirian, which somewhat resemble each other in the square form of their characters, as well as of the Burman, Orissa, Telinga, and Cingalese, which have a more rounded and flourished appearance; of the Tamul, which looks a little like Armenian; of the Afghan and the Persian used in India; and of the Chinese, both as printed from blocks, and from the moveable metal types which have been cast at Serampore.

6. The connexion of the MEDIAN family with the Sanscrit on one side, and with the Greek and German on the other, is sufficiently proved by the words *Abitap*, Zend. *Sun*, Sanscr. *Abiteba*; *Dur*, *Ter*, Pers. *Door*, Sanscr. *Dura*, *Tuwara*, Javanese, *Turs*, Gr. *Thura*, Germ. *Thür*, *Ther*; *Dip*, Pers. *Land* or Island, Sanscr. *Dihp*; *Dochtar*, Pers. *Pothré* Zend. *Daughter*, Gr. *Thûgater*, Germ. *Tochter*, Sanscr. *Putri*; *Jaré*, Zend. *Year*, Sanscr. *Jahran*, Germ. *Jahr*; and *Ishk*, Zend. *Love*, Sanscr. *Itsha*. To this list we may add, from Dr Leyden, *Stree*, Zend. *Woman*, Sanscr. *Stri*; *Asté*, Zend. *He is*, Sanscr. *Asti*, Gr. *Esti*; *Hapté*, Zend. *Seven*, Sanscr. *Saptah*, Gr. *Hepta*. There are also some coincidences with the Chaldee, but the Median is certainly not a dialect of the Chaldee. Sir W. Jones and others have said that the Zendish was nearest to the Sanscrit, and the Pehlvi to the Chaldee or Arabic In ancient Media, the *Zendish* was the language of the northern, and *Pehlvi*, or *Parthian*, of the southern parts; the word Pehlvi or Pahalevi is supposed by Leyden to have been nearly synonymous with Pali or Bali, though this is said to be derived from Bahlika, an Indoeuropean country. The Zendish was more particularly appropriated to religious purposes, and the Pehlvi had in a great measure superseded it for common use at a very early period, under the Sassanides again, from the third to the seventh century, the use of the Pehlvi was discouraged, and the old Persian substituted for it. It is said, however, that in the remote parts of the country, about Shirwan, some traces of the Pehlvi may still be found in existence. The *Zendavesta* of Zoroaster, which is still extant in Zendish, is supposed to have been written 520 years B. C.; and Adelung follows Anquetil in asserting its authenticity, even in opposition to the opinion of Jones and Richardson. These languages have little or no connexion with the Georgian and Armenian, which have succeeded them in some of the same countries. The old Persian, which seems to be much connected with the Pehlvi, has remained in use either as a living or as a learned language ever since the time of the Sassanides; it was current among the Persians when they were conquered by the Arabs in the seventh century; and it is the language of the *Shah Nameh* of Firdusi, written in the tenth century, as well as of the *Ayeen Akbery*, of which the date is about 1600. The modern *Persian* became a cultivated language about the year 1000, having received a considerable mixture of Arabic and Turkish words. The term *Parsee* is commonly applied to a corrupt Pehlvi, spoken by the refugee fire worshippers in Bombay.

The Goths are said to have inhabited, for some centuries, the countries about the Black Sea, and may originally have bordered on Persia; from this circumstance, and probably also from the effects of a later irruption of the Goths into Persia, which is recorded in history, we may easily explain the occurrence of many Persian words in German, and in the other languages of Northern Europe. Professor Adelung has examined more than two hundred

Languages. cases of such resemblances, and has found only one sixth part of them in Anquetil's vocabularies of the more ancient dialects; he has, however, omitted to state what proportion the whole magnitude of these vocabularies bears to that of a complete dictionary of the language. It is well known that an Essay was published a few years since in London, *On the Similarity of the Persian and English Languages;* and a more elaborate work on the relations of the Persian languages, by Mr Le Pileur, has since appeared in Holland. Mr Le Pileur attempts to explain the IS or S of the genitive of the northern languages, by the Persian proposition EZ, which seems to be synonymous with the Greek and Latin EX; but he has not shown that this EZ ever follows the noun to which it relates.

The *Kurds* speak a corrupt dialect of the Persian; they are probably derived from the Carduchi of the Greeks, who inhabited the Gordiaean hills. They spread into Persia about the year 1000, and are now situated on the borders of the Persian and Turkish dominions. The language of the *Afghans*, about Candahar, is said to contain about one fourth of Persian, and some Tartarian, besides the Sanscrit which abounds in it.

7. The ARABIAN family is called by the German critics *Semitic*, from Shem the son of Noah, as having been principally spoken by his descendants. Though not intimately connected with the European languages, it is well known to have afforded some words to the Greek and Latin; it has also some in common with the Sanscrit, though apparently fewer than either the Greek or the German. Thus we have *Acer*, Hebr. a *Husbandman; Ager*, Lat. a *Field; Asther*, a *Star*, Gr. *Aster; Bara, Buri*, Germ. *Burg; Ben*, Hebr. *Son*, Sanscr. *Bun, Child; Esh*, Hebr. *Eshta*, Chald. *Fire*, Sanscr. *Aster;* and *Ish*, Hebr. *Man*, Sanscr. *Isha, Man* or *Lord*. The Hebrew *Ani, Anoki, I*, has been noticed by Townsend and others as affording an etymology for *Ego* as well as for *Ni* or *Mi* of verbs, for the *Anok* of the Egyptians, and even for the *Ngo* of the Chinese.

The northern nations of this family have sometimes been comprehended under the name *Aramaic*, in contradistinction to the middle, or Canaanitish, and the southern, or Arabian. The Eastern Aramaic, or old *Chaldee*, is very little known; it was the language of a people situated in the north of Mesopotamia, which is now the south of Armenia; a part of them extended themselves further south, and became Babylonians; of whose dialect some traces are said still to exist, about Mosul and Diarbeker. The old Assyrians, between the Tigris and Media, were a colony of the Babylonians, and spoke a language unintelligible to the Jews. (II. Kings, 18.) The western Aramaic has become known, since the Christian era, as the *Syriac*, in which there is an ancient and valuable translation of the *New Testament*. It is still spoken about Edessa and Harran. The Palmyrene was one of its dialects; the modern *Assyrian* of the Russian Vocabularies appears to be another.

The language of the Canaanites is said, by St Jerom, to have been intermediate between the Hebrew and the Egyptian. The people are supposed to have come originally from the Persian Gulf; the Philistines, who were found among them, to have emigrated from the Delta to Cyprus, to have been thence expelled by the Phenicians, and to have adopted the language of the Canaanites, when they settled among them. The book of Job is considered as affording some idea of the dialect of Edom; it is well known to contain many Arabisms, besides some other peculiarities. The *Phenician* is only known from a few coins and inscriptions found chiefly in Cyprus and in Malta, and not yet very satisfactorily deciphered, though Akerblad is convinced, by some of them, that it varied but very little from the Hebrew; of its descendant, the *Punic*, or Carthaginian, a specimen is preserved in the speech of Hanno in Plautus, as happily arranged by Bochart; the objection of Adelung, respecting the want of a proper name, appearing to have arisen from a mistake. The last six lines of the text are probably either a repetition of the same speech in the old Lybian of the neighbourhood, or a jargon intended to imitate it.

The *Hebrews* originated among the Chaldeans; Terah, the father of Abraham, having been a native of Ur, or Edessa, beyond the Euphrates; they adopted the language of the Canaanites, among whom they led a nomadic life, till their residence in Egypt, which must probably have had some effect in modifying their language. After that time, however, it appears to have varied but little, in a period of 1000 years, from Moses to Malachi, and this circumstance Adelung considers as so uncommon and improbable, that he is disposed to believe that the writings of Moses must have been modernised, at least as late as the time of Samuel. The old Hebrew became extinct, as a living language, about 500 B. C.; 1000 years afterwards, the Masoretic points were added, to assist in its pronunciation; and this was done in some measure upon the model of the Syrochaldaic, which at that time was still spoken. The Septuagint version, which is much older, supports, in the instances of many of the proper names, the reading indicated by the points, but in about as many others it appears to deviate from that system, and to agree with a mode of pronunciation founded upon the text or principal characters alone. The reading in Greek letters of Origen, in his *Hexapla*, tends, on the whole, very strongly to support the points. The *Chaldee* had superseded the Hebrew at the time of the captivity, and was gradually converted into the *Syrochaldaic*, which is called Hebrew in the New Testament. The Targums, and the Talmud of Babylon, are in the older Chaldee; and a Syrochaldaic translation of the New Testament has been discovered to be still in existence.

The *Samaritan* somewhat resembles the Chaldee; it was formed among the Phenicians and others, who occupied the habitations of the ten tribes, when they were carried into captivity by Salmanassar and Esarhaddon. Its peculiar alphabet is well known as a mere variation of the Hebrew.

The *Rabbinic* dialect was principally formed in the middle ages, among the Spanish Jews, who were chiefly descended from the inhabitants of Jerusalem;

while those of Germany and Poland were generally Galileans, and spoke a ruder dialect of the Hebrew than the fugitives from the metropolis.

The *Arabs* have been a distinct, and in great measure an independent nation, for more than 3000 years. Some of them were descended from Shem; others, as the Cushites, Canaanites, and Amalekites, from his brother Ham. Their language, as it is found in the Koran, contains some mixture of Indian, Persian, and Abyssinian words. Its grammar was little cultivated until a century or two after the time of Mahomet. It is certainly copious, but its copiousness has been ridiculously exaggerated, and absurdly admired. The best Arabic is spoken by the upper classes in Yemen; in Mecca it is more mixed; in Syria corrupt, and still more so in some parts of Africa. There are dialects which require the assistance of an interpreter to make them intelligible; at the same time, it has been maintained by Aryda, a learned Arab of Syria, in contradiction to Niebuhr, that the Arabic of the Koran is still employed in conversation among the best educated of the people, as well as in correct writing. The Arabs living in houses are called Moors; and those of Africa are the best known under this name. The Mapuls, or Mapulets, of Malabar and Coromandel, are a numerous colony of Arabs, who have been settled there above a thousand years.

The *Ethiopians* are descended from the Cushite Arabs. In the time of Nimrod they conquered Babylon: before that of Moses they emigrated into Africa, and settled in and about Tigri; in Isaiah's time, they seem to have extended to Fez; and at present they occupy Tigri, Amhara, and some neighbouring countries. They became Christians in 325, but retained the initiatory ceremony of the Jews and Mussulmen. The pure or literary Ethiopic is called *Geez*, or Axumitic, in contradistinction to the Amharic, by which it was superseded as the language of common life in Amhara, about the fourteenth century, although it is still spoken, without much alteration, in some parts of *Tigri;* while, in others, as in *Hauasa*, a different dialect is spoken. The Ethiopic was first particularly made known in Europe by the elaborate publications of Ludolf. Mr Asselin has lately procured a translation of the whole of the *Bible* into the Amharic, as it is now spoken at Gondar; it was executed by the old Abyssinian traveller who was known to Bruce and to Sir William Jones, and it is said to be now printing at the expense of some of the British societies.

The *Maltese* is immediately derived from the modern Arabic, without any intervention of the Punic. The island, having been successively subject to the Phaeacians, Phenicians, Greeks, Carthaginians, Romans, and Goths, was subdued by the Arabians, in the ninth century; in the eleventh, the Normans conquered it, and it remained united with Sicily, until it became in some measure independent, under the Knights of St John.

8. The LYCIAN is only known from a few short inscriptions, copied by Mr R. Cockerell, and published in Mr Walpole's collection, together with two or three longer ones, which have been lately brought from Antiphellos, by the enterprising and indefatigable Mr W. J. Bankes. By means of a proper name, in one of Mr Cockerell's inscriptions, we obtain a part of the alphabet; thus î is A; Δ, D; E, I; P, R; ʃ, s; and probably Λ, H; and I, L. A further comparison of the different parts of the other inscriptions, with the Greek phrases that almost uniformly accompany them, implying "FOR HIMSELF AND HIS WIFE AND HIS CHILDREN;" gives us the words A, or AT'HI, *himself;* SA, *his*, or *for his*, HRDI, or perhaps HROI, *wife;* TIDAIMI, *son;* TIDAIMA, *children;* and ATBI, *and.* It does not appear that any of these words would authorise us to place the Lycian language as a member of the great Indoeuropean class; but it is reported to have been much mixed with Greek, and on account of its geographical situation, it may be allowed to occupy a temporary rank between the principal Oriental and European languages. If it has a shadow of likeness to any other language, it is perhaps to the Cimbric; and *Tidaimi* may also possibly be allied to the Greek *Titheno,* to nurse.

9. Respecting the ancient PHRYGIAN, we have a few traditions only, which at least agree in giving it a high antiquity, as the source of several Greek words. Thus, Plato observes, in his *Cratylus*, that the terms denoting *fire* and *water* are not derived from any other Greek words, but are Phrygian primitives. It seems, however, that *water* was called *Bedü* by the Phrygians, and the word resembles the *Bada*, *Bath*, of the northern nations, as well as the *Vate*, water, of the Swedes; *Moirai*, the fates, derived from the Phrygian, is compared to *Meyar*, virgins, of the Gothic; and *Bek, bread*, is as much like our *Bake*, as like the Albanian *Buk*, *bread*.

10. The *Greek* has no very intimate or general connexion with any of the older languages, which have been preserved entire, although there are a number of particular instances of its resemblance to the Sanscrit, some of which have been already mentioned; it has also many German and Celtic words, some Sclavonian, and, as it is said, a few Finnish. It can only have been immediately derived from the language of the neighbouring Thracians and Pelasgians, who seem to have come originally from the middle of Asia, through the countries north of the Black Sea, and to have occupied not only Greece and Thrace, but also the neighbouring parts of Asia Minor, where they probably retained their ancient dialect to a later period than elsewhere. The whole of the Thracian states were greatly deranged by the expedition of the Celts, in 278 B. C., which terminated in their settling the colony of Galatia. The Dacians, or Getae, who principally occupied Bulgaria, extended themselves further northwards, and afterwards constituted the Roman provinces of Moesia and Dacia, which were conquered by the Goths, in the third century. The Macedonians, in the time of Alexander, spoke a language which was nearly unintelligible to the Greeks in general; even the Pelasgi, in Epirus and Thessaly, long retained a dialect materially different from their neighbours; and in Arcadia still longer. The Hellenes, who emigrated from Asia Minor into Greece, were not sufficiently

 numerous to carry their own dialect with them, although the language assumed their name. The Graeci in Italy were Pelasgians, although Dionysius of Halicarnassus includes them in the denomination Hellenic; their language must have been Aeolodoric, and it was in this form that the Latin received its mixture of Greek; the Lacedemonian also retained it till a late period, writing, for instance, instead of *Pais, Poir*, as in Latin *Puer*. The *Aeolic* appears once to have extended over Attica, and to have left some Aeolisms in the old *Attic* dialect. This dialect was the principal basis of the *Common* language of Greece at a later period, which must have been the most cultivated under the protection of the court of Alexandria, and which continued to be spoken and written in the highest circles of Constantinople throughout the middle ages; by degrees it degenerated into the modern *Romaic*, having received a mixture of Turkish and Italian, and perhaps of some other neighbouring languages.

11. The GERMAN family is sufficiently connected with a variety of others, belonging to the Indoeuropean class, to be admitted into it upon a very short investigation. Its resemblances to the Greek, within the compass of the Lord's Prayer, besides *Father* and *Name*, are *Wille, Wollen*, Gr. *Boule*, perhaps *Brot* or *Proat, bread*, like *Artos*, and *Freyen* or *Lösen*, like *Rhüein* and *Lüsein*. Dr Jamieson has shown very clearly, in his *Hermes Scythicus*, how immediately the structure of the Gothic languages is derived from that of the Greeks. Thus the EIN of the Greek infinitive became in the Moesogothic *an* or IAN, in German EN; the ICOS of the adjectives, Moesogothic, AGS, IGS, or EIGS, as *mahteigs, mighty*; Germ. *machtig*; the Sclavonians have *ski*, the Swedes *ska*: the INOS, Lat. ENUS, Anglosaxon EN: the LICOS, Latin, LIS, German LICH, English LIKE; thus *pelicos* is *what like*, as least in Scotland; the Moesogothic *swaleiks* is our *such*; *sameleiks* is *similis*. LOS, LIS, LION, of diminutives, in Latin LUS, becomes in Moesogothic ILO, as *barnilo*, a little child; in German *männl* is a little man. Among the pronouns we have EGO in Greek and Latin, Moesogothic IK, Icelandic EG, Swedish JAG; EMOU, MOU, Gr., Latin MEI, Moesogothic MEINA, German MEINER; EMOI, MOI; Latin MIHI, Moesogothic MIS; Swedish MIG, Dutch MY; EME, ME, Latin ME, Moesogothic MIK, Anglosaxon ME, Dutch MY. SÜ, Doric TÜ; Latin TU; Moesogothic THU. Is in Latin, Moesogothic IS; EJUS, Moesogothic IS, IZOS; ID, Moesogothic ITA, English IT; QUIS, CUJUS, CUI, QUEM; Moesogothic QUHAS, QUHIS, QUHE, QUHANA, the last having the N; as the Greek HON; UTER, WHETHER; ALTER, OTHER, seems to be derived from ANTHER, ENTHERA, meaning *one of them*, so that in this instance the Gothic has the appearance of the greater antiquity, while the Greek affords, on the other hand, an etymology for EKEINOS, from EKEI, there, which is wanting to the Moesogothic GAINS or JAINS, the Alemannic GENER, the German JENER, and the English YONDER or YON. Again, among the numerals, DEKA has been derived from DEO, as if both hands were tied together, and PENTE has a strong resemblance to PANTA, as if *all* the five fingers were reckoned: and on the other hand, *da cuig* in Gaelic, meaning twice five, has been considered as the original of DECA. But none of these etymologies seems to be so decisive of originality as that of *caterva*, which is evidently related to *turba* or *turma*; while the first syllable remains unexplained in Latin, but in the Celtic we have *cad tarf*, or *cath tarf*, a *war troop*, agreeing undeniably with the sense. For another example, we may take *ventus* and *wind*, for which we find no Latin etymology, while the German furnishes us with *wehen* to *blow*, and thence *wehend* and *wind*; the words *nodus* and *knot* afford also a similar instance, *nodus* having nothing nearer to it in Latin than *neo* to spin, *necto* to unite; but in German we have *knütten* to *join*, and in English *knit* and *knead* from the same root. The degrees of comparison are expressed in Greek by EROS and ISTOS; in Anglosaxon by ER or ERA, and IST or AST. *Er* seems to mean before, as well as the Latin OR. The Coptic has no comparative, but for *better than I*, the Egyptians said *very good before me*. It would seem at first sight natural to make *than* a preposition, as well as *before*, and to say *better than me*; but the fact is that in English, as well as in German, it was usual of old to say *then* or *denn* in this sense; and *he is wiser than I* meant only, *he is wise* BEFORE, THEN *I follow*. The idea of time or place is now dropped as unessential to the kind of priority in question, but the ground of the grammatical construction remains unaltered. In Moesogothic the comparative termination is IZO or OZO; the superlative ISTS or ISTA; thus the Greek MEIZON becomes MEIZO: and MAISTS is obviously MEGISTOS. The old *megalos* is *mikils*, mickle or muckle; and *minor, minimus*, became *minnizo, minnists*; in Persian *mih* is *great, mihter, greater, mihtras, greatest*; *better* seems to be from the old German *bied* or *bieder, upright, honest*, and resembles the Persian BIHTER, *better*. The Moesogothic verbs have also some striking resemblances in their form to the Latin, thus the present tense of to *have* is HABA, HABAIS, HABAITH; HABAM, HABAITH, HABAND; HABAIT is HABAIDA, HABENS, HABANDS; HABENTIS, HABANDIS; HABENTEM, HABANDAM; HABENTES, HABANDANS. The substantive verb singular in Greek is EIMI, EIS, ESTI; the plural in Latin SUMUS, ESTIS, SUNT; the Moesogothic has IM, IS, IST, SIJUM, SIJUTH, SIND: and SIS is SIJAIS; ESSE, WISAN. The Moesogothic nouns frequently retain the resemblance of the Greek more strongly than their more modern derivatives; thus a TOOTH does not seem to point very immediately to DENTEM or ODONTA as its source; but the older form TUNTHU is clearly the intermediate stage of this modification; and numberless other instances of the same kind might easily be found.

The Germans were known, as early as the time of Pytheas, that is 320 B. C. as consisting of the Jutes in Denmark, the Teutones on the coast to the east of them, the Ostiaeans next, and lastly the Cossini, Cotini, or Goths. Professor Adelung imagines that the eastern nations, or Suevi, employed almost from the earliest times a high German dialect, and the western, or Cimbri, a low German; the Suevi he supposes to have been driven, at a remote period, into the south of Germany by the Sclavonians; and some of the Goths appear to have extended as far as

the Crimea. The *Bible* of Ulphila, in the Gothic or Moesogothic of 360, is the oldest specimen in existence of the German language. Besides the Greek and Latin, which appear to prevail so much in the language, it exhibits a considerable mixture of Sclavonian and Finnish; the translation is far more literal than it could be made in any of the more modern dialects of the German; and sometimes appears to follow the text with somewhat too much servility.

The modern *German*, founded on the higher dialects of Saxony, was fixed and made general by Martin Luther. There are many shades of dialect and pronunciation in the different parts of this diversified country, but none of them of any particular interest, or established by any literary authority. There are still some German colonies, in the territories of Vicenza and Verona, called the Sette Comuni, which retain their language. The *German Jews* have a peculiar jargon, borrowed in some measure from their brethren in Poland, which they write in Hebrew characters; and another similar mixture of discordant dialects is spoken by the Rothwelsh, a vagabond people in the south of Germany, who have sometimes been confounded with the Gipsies.

The *Low Saxon*, or Platt Deutsch, is spoken about Halberstadt, and further north, in the countries between the Elbe and the Weser; it seems to be intimately connected with the Frieslandish and Danish, as well as with the English. The *Frieslanders* originally extended from the Rhine to the Ems, and the Cauchi, thence to the Elbe; these countries still retain a dialect materially varying from those of their neighbours. The Brokmic laws of the thirteenth century exhibit some remarkable differences from the German of the same date: thus we find in them *Redieva* a judge, or *Reeve*, instead of *Richter; Kenne, kin;* and *sida, side*, as in Swedish, instead of *seite*. The Batavian Frieslandish approaches very much to the English; it has several subdialects, as those of *Molkwer*, and *Hindelop*. Some of the Cauchish Frieslanders remain in the territory of Bremen; the North Frieslanders occupy Heligoland, Husum, and Amröm.

The *Dutch* language is a mixture of Frieslandish, Low Saxon, and German, with a little French. It appears, from Kolyn's *Chronicle*, to have been distinctly formed as early as 1156.

The Scandinavian branch of the Germanic family is characterized by the want both of gutturals and of aspirates, which renders its pronunciation softer and less harsh; and by some peculiarities of construction, for instance, by the place of the article, which follows its noun, both in *Danish* and Swedish, instead of preceding it, as in most other languages. The name of Denmark is first found in the ninth century; until the sixth, the people were called Jutes. *Norway*, in the ninth century, was termed Nordmanland. A corrupt Norwegian is still, or was lately, spoken in some of the *Orkneys*, which were long subject to Norway and Denmark. In the eastern parts of *Iceland*, the language is much like the Norwegian; but, on the coast, it is mixed with Danish. The oldest specimen of Icelandic is the *Jus Ecclesiasticum* of 1123. The term Runic relates to the rectilinear characters cut in wood, which were sometimes used by the Scandinavian nations. The *Swedes* are derived from a mixture of Scandinavians with Goths from Upper Germany; but their language does not exhibit any dialectic differences corresponding to this difference of extraction. Mr Townsend has given us a list, from Peringskiold, of 670 Swedish words, resembling the Greek; but it must be confessed that the resemblance is in many cases extremely slight.

The *Saxons* are mentioned by Ptolemy as a small nation in Holstein; whence, in conjunction with the Frieslanders, and the Angles of South Jutland, they came over to England, about the year 450. The Saxons settled principally south of the Thames, the Angles north. At the union of the Heptarchy, the Saxon dialect prevailed, and the Anglish, which nearly resembled the Danish of that time, was less in use; but new swarms of Danes having inundated the north of England, in 787, the Danish dialect was introduced by Canute and his followers; and it is about this period that our earliest specimens of the Anglosaxon are dated. The Saxon dialect again obtained the ascendancy under Edward the Confessor; and although some French was introduced by this prince, and still more by William the Conqueror, into the higher circles of society, the courts of law, and the schools, yet the use of the French language never became general among the lower classes, and the Saxon recovered much of its currency in the thirteenth century, when the cities and corporate towns rose into importance, under Edward the First; in the fourteenth century, it was permanently established, with the modifications which it had received from the French; and it may be considered as truly English from this period, or even somewhat earlier, at least if Pope Adrian's rhymes are the genuine production of 1156. It is still much more German than French; in the Lord's Prayer, the only words of Latin origin are *Trespass, Temptation*, and *Deliver*. Professor Adelung's remarks, on the simplicity of the English language, appear to be so judicious as to deserve transcribing. "The language," he observes "only received its final cultivation at the time of the Reformation, and of the civil disturbances which followed that event; nor did it acquire its last polish till after the Revolution, when the authors who employed it elevated it to that high degree of excellence, of which, from its great copiousness, and the remarkable simplicity of its construction, it was peculiarly capable. It is the most simple of all the European languages; the terminations of its substantives being only changed in the genitive and in the plural, and the alterations of the roots of the verbs not exceeding six or seven. This simplicity depends in some measure on a philosophical accuracy, which is carried systematically through the whole language, so that the adjectives, participles, and article, are indeclinable, being in their nature destitute of any idea of gender, case, or number; and the form of generic distinction is [almost entirely] confined to objects which are naturally entitled to it. The pronunciation, on the other hand, is extremely intricate, and foreign proper names, in particular, are much mutilated, whenever they are adopted by the English."

12. The CELTIC family forms a very extensive and

 very interesting subdivision of the Indoeuropean class. It has been asserted, by some writers, "that the six original European languages, the Iberian, Celtic, Germanic, Thracian, Sclavonian, and Finnish, were just as distinct as the beginning of their history as they now are;" but this assertion must be subjected to considerable modification; the thing is in itself so improbable, as to require far more evidence than we possess to establish it, even if that evidence were of a more decisive nature; and, in fact, it will actually be found, upon a comparison of the Gothic of Ulphila with the more modern dialects, that the Germanic of that day did approach more nearly, both to the Celtic and to the Thracian or Greek, than any of its more modern descendants do. The change of TUNTHU into TOOTH, for which the Germans have ZAHN, has already been noticed; the ATTA and HIMINA of Ulphila seem to be more like the Irish at'air and Neamh, than the modern Vater and Himmel are; and the Moesogothic VAIR, which answers to the Cimbric FEAR, a man, is not at present found in German, though its traces may still be observed in the *Firiobarno* of the Franks, in 1020; the antiquity of the root is shown by the Celtic names in Cæsar beginning so often with VER, and still more strongly by the testimony of Herodotus, that the Scythian called a man AIOR. At the same time, therefore, that we admit the propriety of considering the Celtic and Germanic as families clearly distinct, with respect to any period with which we are historically acquainted, we must not forget that they exhibit undeniable traces of having been more intimately connected with each other, and with their neighbours, in the earlier stages of their existence. The resemblances of the Celtic to the Latin are too numerous to require particular notice, the immediate and extensive connexion between these languages being universally admitted; but if any evidence were desired on this subject, it might be obtained in abundance, by a reference to Court de Gebelin's *Monde Primitif.* With respect to the Greek, the terms *Hael*, sun; *Dur*, water; *Deru*, oak; *Garan*, crane; *Crunn*, ice, are among the Celtic words of the most indisputable originality, and their resemblance to *Helios, Hüdor, Drüs, Geranos*, and *Crüoen*, is equally undeniable. We find, also, in the Cimbric, *Bas*, low, connected with *Bathüs, Bara*, bread, perhaps with *Bora*, food; *Deyrnas*, kingdom, with *Türannis; Dyro*, give, with *Doreue;* and *Gogoriant*, glory, perhaps with *Gauriaon*, exulting. With the German it is easy to find a number of very near approaches to identity, even in that Celtic, which can be proved, principally from the etymologies of proper names, to be prior to the date of any known or supposed secondary intercourse or mixture of the natives concerned; thus we have, either accurately or very nearly in the same signification, *Ap, Affe*, or *Ape; Barra, Barre; Bleun, Blume; Bolgan, Balge; Brig, Berg; Brogil, Brühl: Carra, Karre; Doga, Teich; Galb, Kalb; Garan, Kranich; Gnabat, Knabe; Lancea, Lanze; Marc, Mähre; Marga, Märgel; Redya, Reiten; Rit*, or *Rat, Rad;* and *Ur, Auer;* and it is impossible to suppose that so numerous a series of coincidences can have been derived from accidental causes only.

The Celts may be imagined to have emigrated from Asia after the Iberians, or Cantabrians, and before the Thracians, or Pelasgians, settling principally in Gaul, and spreading partly into Italy, under the name of Ausonians and Umbrians. In 570 B. C., they undertook expeditions, for the purposes of conquest, but they were subdued by the Romans. Their language was current in Gaul till the sixth or seventh century, when it was superseded by the rustic Roman, which by degrees became French: in Ireland and Scotland, it has remained with few alterations; in Wales and Britanny, it has been more mixed. The Gauls must have peopled Britain at least as early as 500 B. C. The true ancient Britons are the Highlanders of Scotland only, having been driven northwards by the Cimbri; they still call their language Gaelic. The Irish are probably derived from these Highlanders; they were originally termed Scots or Scuits, that is, fugitives, from the circumstance of their expulsion from Britain; so that, where the Scots are mentioned before the tenth century, as by Porphyry, in the third, we are to understand the Irish. Gildas, in 564, sometimes calls them Scotch, and sometimes Irish. After the retreat of the Romans from Britain, a part of them re-entered Scotland, about the year 503, and changed its name from Caledonia to Scotia Minor. In 432, St Patrick laid the foundation of the civilisation of Ireland; and, in the seventh century, several Irish priests undertook missions to the continent. At the beginning of this century, some Scandinavian freebooters had begun to visit Ireland; and, in the year 835, they formed large colonies of emigrants, who established themselves firmly in that country, and in the Scottish Islands, bringing with them many Gothic words, which became afterwards mixed with the Celtic, and which seem to constitute about one fifth part of the modern Irish and Gaelic, 140 Gothic words being found under the first six letters of the alphabet only. Some of these Normen remained distinct from the Irish till the year 1102. The oldest specimens of the Irish language, admitted by the continental critics to be authentic, are of the ninth century; though some of our antiquaries have imagined they have discovered records of a much earlier date. The Gaelic of the Isle of *Man* is mixed with Norwegian, English, and Welsh. A Gaelic colony, formerly established at *Walden*, in Essex, has been placed by Chamberlayne in Italy, as a nation of *Waldenses*.

The *Cimbric* or Celtogermanic language was remarked by Cæsar as differing from the Gallic, although the distinction has not always been sufficiently observed. The Cimbrians seem to have existed as a nation 500 or 600 years B. C.; the Gauls called them Belgæ; they invaded Britain a little before Cæsar's time, and drove the ancient inhabitants into the Highlands and into Ireland. Having called the Saxons to their assistance against the Scots and Picts in the fifth century, they were driven by their new allies into Wales, Cornwall, and Britanny. Their language is remarkable for the frequent changes of the initial letters of its radical words, in the formation of cases and numbers; thus from *Den*, a man, in *Britannish*, is derived the plural *Tud;* from *Vreg*, a woman, *Groages*. Almost half of the

Welsh language seems to be German, and half of the remainder is perhaps Latin or Celtic; of the Britannic about half resembles the Latin or French. Britanny was originally inhabited by the Armoricans; whether they were properly Belgae or Gauls is uncertain; the country was named Britannia Minor from the emigration of the British in 449; these new comers mixed with the original inhabitants, all speaking the same language, and in a few years became so numerous, as to be able to send an army of 12,000 men to the assistance of the Emperor Anthemius.

Professor Adelung is disposed to consider the German portion of the different branches of the Celtic, which varies from one fifth to one half of the whole language, as an accidental mixture, and derived through different channels. But we cannot in all cases find any historical evidence of the existence of these channels; it is difficult, for example, to suppose that the Scandinavian incursions were able at any early period to influence the language of the Highlands of Scotland; and wherever it happens, as it frequently does, that no term is to be found, in the Irish, the Gaelic, or the Welsh, for expressing the same idea, besides the word that they all have in common with the German, it is scarcely possible to believe that there ever was any other Celtic word, which has been so uniformly superseded by independent causes. We find, for instance, under the two first letters of the alphabet only, the words *Ap*, or *Apa* in Irish, *Ap* in Welsh, *Affe* or *Ape* in Gothic; again *Abal, Afal, Apfel; Angar, Aneang, Enge; Bacuil, Bach, Backen; Barrad, Barr, Bare; Beoir, Bir, Bier; Bail, Bwall, Beil; Bocan, Bwch, Bock, Brathair, Brawd, Bruder; Bul, Bwla, Bulle;* and the same agreement is found in almost all other instances of German words that are detected in the Irish language.

The much disputed question, respecting the antiquity of the poems attributed to Ossian, has an immediate reference to the history of the Celtic languages. It has been observed with apparent justice, by Professor Adelung, who is not in general sceptical on such occasions, that if these poems were really very ancient, their language could not but exhibit marks of antiquity; there is an Irish *Leavre Lecan*, at Paris, written in the thirteenth century, and scarcely intelligible to the best Irish scholars of the present day; the oldest Gaelic manuscripts have also peculiar expressions no longer in use; while the works, supposed to be the productions of a period so much more remote, are found to be in "excellent modern Gaelic, impressed with all the marks of the language of Christianity, and of that of the Norwegian invaders, whether these conquerors may be supposed to have influenced the Gaelic language immediately in Scotland, or by the intervention of Ireland." It must not, however, be forgotten that these marks of Scandinavian intercourse are somewhat more ambiguous than Professor Adelung is disposed to admit; and that a book written in the thirteenth century is more likely to have preserved the language in an antiquated form, than poems so marvellously committed to memory from continual recitation only, by people supposed to understand them, and of course imperceptibly modifying the expressions without intending to alter them. But since an invasion from Lochlin, that is, Denmark or Norway, is actually mentioned in "Fingal," the author of the poem could certainly not have been older than the seventh or eighth century, if we are to credit the historical accounts of these invasions; and since in the poems discovered by Dr Matthew Young, St Patrick is introduced discoursing with Ossian respecting the Christian religion, we have an additional argument for denying that he was contemporary with Caracalla or Carausius; these Emperors having both lived in the third century, and St Patrick in the fifth.

14. The ETRUSCAN is only known as the immediate parent of the Latin, but it was written in a character totally different, and was read from right to left. Notwithstanding the industry and ingenuity of Lanzi, the evidence of the accuracy of his interpretations is somewhat imperfect. We should naturally have expected to find more words of a Celtic or Gothic origin, and not merely Greek or Latin words, with the terminations a little varied, as *Ustite* for *Ustura*, *Tribo* for *Tribus*, and *Urte* or *Urta* for *Heorte;* still less should we have expected that the same sense should be expressed sometimes by a Greek, and sometimes by a Latin word, as *Urtu* and *Puni* for Bread, *Capros* and *Feres* for a Boar. The Etrurians and Umbrians were originally a branch of the Celts, from Rhætia, as is shown by the similarity of the names of places in those countries, as well as by the remains of Etruscan art found in that part of the Tyrol; they are supposed to have entered Italy through Trent, about the year 1000 B. C., and to have afterwards improved their taste and workmanship under the auspices of Demaratus of Corinth, who settled in Etruria about 660 B. C.

15. The LATIN language is placed at the head of a family, rather with regard to the number of its descendants, than to the independence of its origin, being too evidently derived from the Celtic, mixed with Greek, to require particular comparison. The first inhabitants of Italy appear to have been Illyrians or Thracians, Cantabrians, Celts, Pelasgians, and Etrurians. Rome, from its situation, would naturally acquire much of the languages of these various nations, and at the same time much of the Greek from the colonies in the south of Italy. In the time of Cicero, the Italian songs, supposed to be about 500 years old, were no longer intelligible, even to those who sang them. We find, in an inscription still more ancient, and approaching to the time of Romulus, *Lases* for *Lares;* and for *Flores, Pleores*, which is somewhat nearer to the Celtic *Bleun;* in the time of Numa, for *Hominem liberum*, we have *Hemonem lœbesom;* we find, also, a D added to the oblique cases, as *Capited* for *Capite*, which, as well as the termination AI, in the genitive *aulai, pennai*, is taken immediately from the Celtic, and is even found in modern Gaelic.

The Latin remained in perfection but a few centuries; in the middle ages, a number of barbarous words were added to it, principally of Celtic origin, which are found in the glossaries of Dufresne and Charpentier. At the end of the seventh century, it

began to acquire the character of *Italian*, as *Campo divisum est;* and, in the eighth century, in Spain, we find, as an example of its incipient conversion into Spanish, *Vendant sine pecho, de nostras terras.* The formation of the Italian language may be said to have been completed by Dante, in the beginning of the fourteenth century; and it was still further polished by the classical authors who immediately succeeded him. It contains many German words, derived from the different nations who occupied in succession the northern parts of Italy, and some Arabic, Norman, and Spanish, left by occasional visitors in the south. It is spoken by the common people in very different degrees of purity. Among the northern dialects, that of *Friuli* is mixed with French, and with some Sclavonian. The *Sicilians*, having been conquered in succession by the Greeks, Carthaginians, Romans, Byzantines, Arabs, Normans, Germans, French, and Spaniards, have retained something of the language of each. *Sardinia* has given shelter to Iberians, Libyans, Tyrrhenes, Greeks, Carthaginians, Romans, Vandals, Byzantines, Goths, Lombards, Franks, Arabs, Pisans, and Arragonians; and the proper Sardinian language is a mixture of Latin with Greek, French, German, and Castilian. Corsica has also been occupied by a similar diversity of nations; its peculiar idiom is little known; but the dialect of the upper classes is said to approach nearly to the Tuscan.

Spain, after its complete subjugation by the Romans, enjoyed some centuries of tranquillity. The Vandals and Alans retained their power in Spain but for a short time; the Suevi, on the north coast, somewhat longer; and, from these nations, the rustic Roman, which had become general in Spain, received some words of German origin; it derived, however, much more from the Arabic, during the domination of the Moors, which lasted from the beginning of the eighth century to the end of the fifteenth; and, at one time, the Arabic was almost universally employed throughout the country, except in the churches. The *Spanish* language advanced the most rapidly toward perfection during the height of the national prosperity, which immediately followed the conquest of America; it was afterwards neglected, and again more particularly cultivated by the Academy of Madrid, in the eighteenth century; as far, at least, as an Academy can be supposed to have any influence in the modifications of a language.

The *Portuguese* is supposed to have received a mixture of French from the followers of Count Henry of Burgundy, under whom Portugal first formed a separate state, in 1109; but the language is very different from that of the confines of France and Spain; and the nasal vowels, which are remarkable in the Portuguese, differ materially from those of the French, or of any other nation. Many Latin words are retained in the Portuguese, which are not found in any other modern language; and it is remarkable that almost all the words of the language are contracted, by the omission of some of the radical letters of the originals.

The Rhætians, in the country of the Grisons, were subdued by the Romans in the time of Augustus. They became part of the Alemannish kingdom, under Theodobert, in 539; their union with Switzerland took place in the beginning of the fourteenth century. Half of the Grisons speak the *Romanish* language, immediately derived from the Latin, though mixed with some German, which has been particularly made known by Mr Planta's account of it, in the *Philosophical Transactions.* One third speak German, with some mixture of Romanish words, and the rest a bad Italian.

France, in the time of the Romans, was occupied by the Gauls, together with the Aquitanians, who were probably Cantabrians, and the Cimbrians or Belgians. From the rustic Roman, mixed with the languages of these nations, the *Romance* was gradually formed. In the fifth century, the Francs took possession of the north-eastern part of the country; they retained their language for some centuries, but by degrees it became mixed with the Romance, and formed *French*, of which at least one fifth is supposed to be of German origin; though many of the German words seem to have been admitted through the medium of the Italian. In the south of France, the language remained more exempt from the influence of the German, under the name of the *Provençal;* and the troubadours contributed, especially from the eleventh to the thirteenth century, to give it refinement and currency; but, in later times, the *Langue d'oui* has prevailed over the *Langue d'oc*, which is now spoken by a few of the lowest class only.

The last and least genuine of the descendants of the Latin is the *Wallachian*, about one half of which is borrowed from the German, Sclavonian, and Turkish. The original Thracians of the country must have been in a great measure superseded by the successive settlements of various nations; in the third century, some of the Goths and Vandals; in the fourth, the Jazyges, after Attila's death; in the fifth, some Huns and Alans; about the end of the seventh, the Bulgarians, and afterwards the Petschenegers and Hungarians established themselves in it; and, in the thirteenth century, Wallachia became an independent state. The Latin part of this language has much of the Italian form, and had even assumed it as early as the fifth century. It must have been derived from Roman colonies, and more lately, perhaps, from the missionaries sent into the country by Pope Gregory XI. The *Dacian* or Hungarian dialect prevails on the north of the Danube; the *Thracian*, or Cutzowallachian, on the south; the latter is more mixed with Greek and Albanian. There is also a small Wallachian colony in Transylvania.

The *Cantabrian* or *Biscayan* has many words in common with the Latin, whether originally or by adoption, and was probably in some measure connected with the Celtic dialects, which were the immediate predecessors of the Latin, though still sufficiently distinct from them. The Cantabrian *Aita*, Father, has some resemblance to the Irish *Athair*, and the Moesogothic *Atta; Seru* is not wholly unlike *Coelum; Ereenjaa, Regnum;* and *Borondatia, Voluntas;* the coincidence of *Gun*, Day, with the Tartarian, is perhaps more accidental. But the word *Lurre*, Earth, which seems at first sight so unlike any

other language, is in all probability the derivative of *Tellure;* and this form of the word affords, also, a connecting link with the Irish *Talu,* and may have been contracted into the more common Latin word *Terra;* a supposition which seems to lessen the probability of the original connection of this form of the word with the Greek *Era,* and the Sanscrit *Stira.* The Biscayan is still spoken in the angles of France and Spain, adjoining to the northern extremity of the Pyrenees. The same people were called Cantabrians in the north, and Iberians in the south, and extended between the Pyrenees and the Rhine, as Ligurians, or inhabitants of the coast. They have adopted a few German words, perhaps from the empire of the west Goths; and they have furnished the modern Spanish with more than a hundred original words of their own. The construction of the language is extremely intricate; its verbs have eleven moods, among which are a consuetudinary, a voluntary, a compulsory, and a penitudinary. Larramendi's *Grammar,* published at Salamanca in 1729, is called *El Impossible Vencido.* A valuable abstract of the most interesting particulars relating to the language is found in the *Additions to the Mithridates,* by the Baron William von Humboldt, late Prussian Ambassador to the Court of Great Britain, printed at Berlin, 1816. Dr Young has lately remarked, in the *Philosophical Transactions* for 1819, that at least six of the words contained in Humboldt's vocabulary coincide very accurately with the Coptic, or ancient Egyptian, though they are not found in any of the languages of the neighbouring countries; and he infers that the chances are "more than a thousand to one, that, at some very remote period, an Egyptian colony established itself in Spain." It may be observed, that one of these words, *guchi,* little, appears to be also Turkish or Tartarian; so that it becomes a second instance of a coincidence between this language and the Cantabrian.

16. The connexion of the Sclavonian and Lithuanian, and of the other branches constituting the SCLAVIC family, with the languages of the Indoeuropean class in general, is sufficiently established, without exceeding the limits of the Lord's Prayer, by the resemblance of *Nebi* or *Nebesi* to the Cimbric *Nefoedd,* and the Greek *Nephos,* and of *Wolja* and *Chljeb* to the Gothic *Wilja* and *Hlaif.* The *Sclavonians* are the descendants of the ancient Sarmatians, who were situated north of the Black Sea and of the Danube. They were conquered by the Goths, and then driven by the Tartars and Huns into the north-east of Germany, and the neighbouring countries. Procopius calls them Spori, and divides them into the Sclavi and the Antes, the latter, perhaps, the same as the Wends. They formed, at an early period, two principal states, Great Russia, about Novogorod, and Little Russia, on the Dnieper, its capital being Kiew. The Russ were a Scandinavian branch, under Rurik, to whom the Sclavonians of the former state submitted in 862, whence they were called Russians; and Rurik's successor, Oleg, conquered Kiew. After several vicissitudes, the Russians were liberated by Iwan Wasiliewitch, at the end of the fifteenth century; and this period was the beginning of their greatness. Their language has some mixture of Greek, Finnish, Swedish, Tartarian, and Mongol. The ecclesiastical dialect was uniformly retained in all literary works, in the former part of the last century, but now the language of conversation is generally adopted in writing. This language is more immediately derived from that of Great Russia; that of the church, which is called the Slawenish, rather from Little Russia, and especially from the dialect of Servia. The *Malorussian* dialect is somewhat mixed with the Polish, and is spoken in Ukrain and Little Russia; the *Susdalian* is mixed with Greek and other languages, and is spoken in Thrace.

In 640, the Sclavonians took possession of Illyria, which before that time had been overrun by a variety of other nations, and they still retain it, under the names of Servians, Croatians, and Southern Wends. The *Servians* are supposed to have come from Great Servia, now East Gallicia, on the Upper Vistula; the *Croatians* from Great Chrobatia, probably situated on the Carpathian mountains. Cyril first adapted the Greek alphabet to the Sclavonian language in Pannonia; his letters were afterwards a little altered, and attributed to St Jerom, in order to reconcile the people to their use, and in this form they are termed Glagolitic characters. The Servian dialect is intermediate between the Russian and the Croatian. The Bulgarians speak a corrupt Sclavonian, which Boscovich, from *Ragusa,* could scarcely understand. The *Uskoks* are a wild race of the Bulgarians extending into Carniolia, and speaking a mixed language. The dialect of Slavonia and Dalmatia is nearly the same as that of Servia and Bosnia; the churches use the ecclesiastical language of Russia. In Ragusa, the orthography approaches, in some measure, to the Italian. The Servian is also imperfectly spoken by a small colony in Transylvania. The southern *Wends* were first distinguished in 630, and were probably so named, like the Veneti, from being settled on the shores of the Adriatic, the word *Wend* or *Wand* meaning Sea. They are now mixed with Germans in Carniolia, Carinthia, and Lower Stiria. In Hungary, there is a small colony, who call themselves Slowens, and speak the *Wendish* dialect of the *Sclavonian.* The western Sclavonians, or the proper Sclavi, write their language in the Roman characters; but the specimens, copied from Adelung, are accommodated in their orthography to the German mode of pronunciation.

The *Poles* probably came with the Russians from the Danube into the countries abandoned by the Goths; the name Pole implies an inhabitant of plains. Their language was partly superseded by the Latin in the tenth century, when they received the rites of the Latin church; but it has in later times been more cultivated. The Cassubians, or Kashubians, in Pomerania, speak a Polish mixed with a little German. In Silesia, the names of places in the plains are Sclavonian; in the hills, more lately occupied, German; but German has been the language of Breslau ever since the year 1300.

The *Bohemians* emigrated, with the Moravians and Slowaks, into their present habitations, about the middle of the sixth century, after the destruc-

 tion of the kingdom of Thuringia by the Franks and Saxons. There is a Bohemian hymn of the date 990, and a chronicle in rhyme, of 1310. One third of the Bohemians are of German origin, and speak a corrupt German.

The *Serbs*, or Wends, came about the same time into the countries between the Saal and the Oder, from the neighbourhood of the Volga or the Crimea; a few of them are still left in *Lusatia*, under the name of Wends or Sclavonians, and some in Misnia. In Pomerania the Wendish became extinct about 1400; but the *Polabes* in Lüneburg, on the Leyne, kept up till lately a language consisting of a mixture of Wendish and German. The *Sorabic* of the Russian vocabulary seems to be the same with this Serbian.

Of the *Lithuanian* or *Lettish* language, two thirds are Sclavonian, the rest is principally German. When the Goths had removed from the Baltic towards the Black Sea, their neighbours the Aestii remained for some hundred years independent, till in the sixth century the Sclavonians incorporated themselves with them, and formed the Lettish people and language. The *Old Prussian* was spoken, at the time of the Reformation, in Samland and its neighbourhood, but it is now lost; it contained more German than the other Lithuanian dialects. The *Prussian Lithuanian* is spoken from the Inster to Memel, especially in Insterburg. The *Polish Lithuanian*, in Samogitia, has a little mixture of Polish. The proper *Lettish* is current in Lettland and Courland, it is purest about Mittau and Riga; the old Courlanders having been Fins, this dialect has received a little Finnish from them. The *Crevingian* is another dialect, spoken by the Krewins in Courland.

17. The Tshudish or Finnish, the Hungarian, and the Albanian languages, have some traits of resemblance to each other; they are placed as forming the *Sporadic* or scattered order of the great *Tatric* or Asiatic class, being in some measure geographically detached from the rest, and scattered through different parts of Europe: they immediately follow the Indoeuropean class, as exhibiting an occasional resemblance to some of the languages contained in it, though not enough to make it certain that the connexion is essential or original; thus the Finnish is said to have some coincidences with the Greek, the Laplandish with the Hebrew, the Hungarian with the Finnish, and the Albanian with all its neighbours.

The term *Tshudish* is employed as comprehending the Fins, Laplanders, Esthonians, and Livonians; a race of people of unknown origin; but in all probability unconnected with the Huns or Mongols. Their languages are remarkable for the great complexity of their structure; their nouns, for example, having from ten to fifteen cases, among which are reckoned, in the Finnish, a nuncupative, a conditional accusative, a factitive, a mediative, a descriptive, a penetrative, a locative, a privative, and a negative. The Esthonian has less direct variety of termination, but several intricate combinations. There is also a great multiplicity of dialects, partly from a mixture of Scandinavian, and partly from other causes; in Lapland almost every church has a peculiar version of the service kept for its use. The *Finnish* is intermediate between the *Laplandish* and the *Esthonian*. The Esthonians are the Aestii of the Romans, the name implying Easterly, and being appropriate to the country, and not to the people. The principal dialects of their language are those of Reval and of Dorpat: some authors also consider the dialect of the Krewins in Courland as belonging to it. The *Livonian* is much mixed with other languages, and has been almost superseded by the Lettish. Among the Laplandish words, which Rudbeck has derived from the Hebrew, we find *Aedhame*, Earth, like the Hebrew *Adameh*; *Hadas*, New, H. *Khadesh*; *Hadshe*, the Moon, H. *Hhadesh*; *Jed*, the Hand, H. *Id*; *Ise*, Man, H. *Ish*; *Pothi*, persuaded, H. *Pathehh*; *Saedke*, law, H. *Tzedek*; and *Safothi*, rested, H. *Sabbath*. In the Finnish, *Kana* is something like the English and German *Hen*.

18. The *Hungarians* inhabited in the fourth century the country of the Bashkirs, between the Tobol, the Volga, and the Jaik, perhaps as colonists, since their name signifies strangers; their language was spoken in this neighbourhood as late as the thirteenth century; in the sixth they were conquered by some of their Turkish neighbours; in the end of the ninth they were forced by the Petschenegers, a Tartarian nation, to remove nearer to the Carpathian mountains. They were then engaged in the German wars, and their country having been occupied during their absence by the Bulgarians, they took possession of the Bulgarian kingdom on the Theiss, as well as of Pannonia. Their language is somewhat like the Finnish, but the people are very different from the Fins in appearance; which might indeed be the effect of a difference of climate; but in fact the language appears to be still more like the Sclavonian, with a mixture of a multitude of others; it has some words from various Tartarian dialects, German, French, Latin, Armenian, Hebrew, Persian, and Arabic; but it has no traces of the Mongol, nor is it possible that the people can be descendants of the Huns, whose character and cast of features can never be eradicated. The word *Coach*, so general in Europe, is originally Hungarian, having been derived from the town of *Kots*, where coaches are said to have been invented. The Szecklers, in Transylvania, speak a language like the Hungarian; it is uncertain whether they are a Hungarian colony, or remains of the Petschenegers; but, however this may be, there is little doubt that the Hungarians are principally of Tartarian extraction, though much mixed with other nations.

19. The *Albanians* speak a language, of which a considerable portion is Greek, Latin, German, Sclavonian, or Turkish; but the rest seems to be perfectly distinct from any other language with which we are acquainted. They are probably connected with the Albanians between Mount Caucasus and the river Cyrus, who are supposed to be derived from the Alani; some of them seem to have entered Bulgaria as late as 1308. In 1461, many of them fled from the Turks to *Italy* and *Sicily*, where they still exist near Reggio and Messina. The Clemen-

tines are an Albanian colony, who followed the Austrian army in 1737; such of them as escaped from the pursuit of the Turks established themselves in Syrmia.

20. The languages referred to the *Caucasian* order have little to distinguish them from the rest of the class, except their geographical situation, in the immediate neighbourhood of the Caucasian mountains. They have a general resemblance to some others of the languages of Northern Asia, and particularly to the Samojedic dialects, spoken on the mountains between Siberia and the Mongols. Except the Armenian and Georgian, they are scarcely ever employed in writing; and principally, perhaps, from this cause, they exhibit as great a diversity in the space of a few square miles, as those of many other nations do in as many thousands. It is only *conjectured that most of the inhabitants of these countries are derived from the miscellaneous fragments of expeditions of various nations, left behind in their passage through them at different periods.*

The connexion of the *Armenian* with the Sanscrit and the Persian is just enough to make it equally possible, that the coincidences may have been derived from a common parent, or that one language may have simply borrowed detached words from the other. We find, in different parts of Mr Townsend's work, about ten Armenian words resembling some other language; these are, *Air*, a man, *Air*, Irish; *Atamn*, a tooth, *Odonta*, Greek; *Chuerk*, four, *Chatur*, Sanscrit; *Dor*, a *Door; E*, is, *Est*, Latin; *Es*, I, *Iaze*, Russian; *Gas*, a *Goose*, *Gans*, German; *Houze*, a *House; Lakel*, to *lick*, *Leichein*, Greek; and *Sirt*, the *Heart*. Nothing is known of the history of the Armenian before the time of Miesrob, who translated the *Bible* into it, in 405; the historian Moses, of Chorene, was his pupil. The language flourished till the year 800, and is still preserved in tolerable purity, in the cloisters. The common people speak a dialect more corrupt and mixed. The Fathers of the Armenian convent at Venice have been very laudably employed in the improvement of the literature of their nation, by the publication of several very elegant editions of Armenian books, which have been executed at their press; in particular, of an Armenian translation of Eusebius, containing some passages which are not extant in Greek, and said to have been copied from a manuscript of great antiquity at Constantinople; it is, however, very remarkable, that, as they candidly confess, the copy, when first received by them, contained the corrections and additions of Scaliger, in conformity with the text of the printed Greek edition, and the copyist, when questioned, asserted that he had merely translated and inserted passages of his own accord, and in silence, in order to make the work *more perfect*. Still the Armenian Eusebius is a very handsome book, and every way calculated to do credit to the Venetian editors and their patrons; a Latin translation of it only has been published by Angelo Mai at Milan.

21. The *Georgians* are supposed to have derived their name from the river Cyrus or Gur, and to have extended formerly to Colchis, under the denomination of Iberians. Moses of Chorene, in the fifth century, mentions the Georgian translation of the *Bible*. The old language is still preserved in the churches, and the common dialect of the country is derived from it, together with the *Kartuelish, Imirettish, Mingrelish*, and *Suanetish*, which are varieties of that dialect; the *Tushetish* is mixed with some Kistic. The Georgians have no fewer than thirty seven letters, and among them a variety of aspirates and sibilants, of no very agreeable sounds.

22. The ABASSIC nations seem to be the oldest inhabitants of the Caucasian country; (23.) the CIRCASSIANS are situated to the east of them, on the promontory of North Caucasus; (24.) the OSSETES, on the left of the Terek, north of the mountain; the dialect of the *Dugors* is scarcely distinguishable from this: (25.) the KISTIC, spoken by the *Ingushans*, and their neighbours, at the head of the Terek, is connected with the Tushetic Georgian. 26. The LESGIANS, east of Caucasus, on the Caspian Sea, have a number of distinct dialects, or rather languages; thus, the *Chunsag*, and *Avaric*, the *Dido*, the *Kasi Kumuk*, the *Andi*, and the *Akushan*, have little connexion with each other, except that the Dido somewhat resembles the Chunsag, of which the Avaric, the *Antsug*, and the *Dzhar*, seem to be subordinate dialects. The Kasi Kumuk appears to have adopted some words of the Armenian, and the Andi and Akushan of the Georgian. The dialect of Kubesha resembles that of Akusha, and retains no traces of a supposed European origin.

27. The languages of the central and elevated parts of Asia are comprehended in the order *Tartarian*; they extend from the Caspian Sea to the mouth of the Amur, through countries which have been, in former ages, the constant scenes of emigration and barbarism. The *Turcotartarians* are supposed to correspond to the descendants of the Magog of the Scriptures, and to some of the Scythians of the Greeks. The Turks of Turkestan seem to have been the Massagetæ and Chorasmii of the ancients; their country extended North of Persia and Tibet, from the Caspian to the Altaic mountains. In the twelfth century, they were brilliant and victorious; at present, a few of their descendants only are left in the neighbourhood of the Mongols, and their language is no longer spoken; the Turcomans, scattered in Persia and Arabia, are derived from the same race. The Osmans, now commonly called Turks, left Turkestan in 545, and succeeded in the conquest of Persia. They were denominated Osmans, from one of their leaders, in the fourteenth century; their language has been much mixed with Arabic and Persian. This language, with the neighbouring dialects, has been considered in the table as belonging to a family called *Caspian*, the word Tartarian having been previously applied to the whole order; several of these dialects exhibit a mixture of words from the language of the Mongols, which, as well as the Calmuk, has a sufficient connexion with them to be arranged as belonging to the same Turcotartarian family: it would, perhaps, be equally correct to consider some of them rather as distinct languages than as dialects of a single one; but it is not easy to discriminate those which are entitled to this rank; and, on the other hand, some specimens have been admitted, from the Comparative Voca-

 bularies, which scarcely deserved to be noticed as separate dialects. The *Bucharians* are situated between the Oxus and Jaxartes, on the river Koly; they still retain some traces of a superior degree of civilization, by which they were once distinguished; their language is little known, but it seems to be at least as much connected with the Median and Arabian families as with the Caspian. The Tartars were described by the terms Scythians, Bulgarians, Avari, and other appellations, before they were conquered and united by Genghizkhan the Mongol; in the year 1552, they became subject to the Russians. The most westerly are, the *Nogaic* or Nagaic, and Crimean Tartars; their language is much like the Turkish, but mixed with some Mongol. Those of Cumania in Hungary have now forgotten their original language, and speak the Hungarian; the last person who understood the Cumanian having died in 1770; they entered Hungary in 1086, and became Christians in 1410. The Tartarian, or rather Caspian, is spoken in great purity about *Kasan;* a dialect somewhat different in Orenburg; and another by the *Kirgishes,* who occupy part of the ancient Turkestan. "Among the Siberian Tartars, the remains of the kingdom of Turan, some are Mahometans; others, as the Turalinzic villagers, have been made Christians; at least, the Archbishop Philophei performed the ceremony of baptizing them, by ordering his dragoons to drive them in a body into the river." The inhabitants of the banks of the *Tara,* a branch of the Irtish, are said to be derived from the Bucharians. The *Tshulimic* Tartars enjoy the same advantage as the Turalinzic, and are considered as Christians by the Russians. The *Teleutes,* in Sonjor, are heathens, nearly like the Shamanites of India. The *Jakuts* extend along the Lena to the sea; their language contains some Mantshuric and some Tungusic; that of the Tshuwashes, on the Volga, is said to have been once completely distinct from the Tartarian or Caspian, and even at present, though more mixed with it, may require to be classed as forming a separate species.

The *Mongols* are marked by their features as a race very different from the other Tartars; the character of their countenance seems to be easily propagated from father to son, and never to be completely effaced; their original habitation appears to have been in the neighbourhood of the Altaic mountains. The description of the Huns, found in Ammian, Procopius, and others, agrees exactly with the present Mongols, whom the Chinese still call *Kiong nu;* and more particularly with the Calmucks: the proper names of the Huns are also found to be explicable from the Mongol language. In the first century they were driven westwards by the Chinese: under Attila they penetrated into the middle of Europe; and they were little less successful at subsequent periods, under Genghizkhan and Timur Leng. When they were expelled from China, after having held it in subjection for more than a century, they carried back no civilization with them; nor was either of the languages permanently affected by this temporary mixture of the nations, although the physiognomy of the Chinese bears ample testimony of its having once existed. The construction of their language seems to be very indirect and figurative. Mr Townsend has copied from General Vallancy a long list of words, in Strahlenberg's *Mongol Vocabulary,* which agree very remarkably with the Irish; among these we find *Are* and *Ere,* man, Irish *Ar, Air, Fear; Arul,* a spindle, Irish *Oirle; Alemamodo,* an apple tree, Irish *Amhalmhaide; Asoc,* to ask, Irish *Ascadh; Baichu,* I live long, Irish *Baoth,* long life; *Bugu,* a buck, Irish *Boc,* a he goat; *Choy* a ewe, Irish *Choi;* and *Choraga* a lamb, Irish *Caorog,* without going any further in the alphabet. The last two instances are very striking, and seem to point very strongly at the part of the east from which the Celts may be supposed to have originally emigrated. The *Calmuck* dialect is somewhat mixed with the neighbouring Tartarian. The Tagurians, or Daurians, between the lake Baikal and the Mongol hills, are said to be of Mantshuric origin; but their language evidently resembles the Calmuck. The *Burattish* is from the Russian Vocabularies.

28. The *Mantshurians* are sometimes improperly called Eastern Mongols; they are subjects of the empire of China. Their language is rude, and not much like the Chinese, though evidently derived from the monosyllabic class; it has some few words in common with the European languages, as *Kiri,* patient; *Kirre,* German, *Cicur,* Latin, tame; *Furu, Furor; Lapta,* rags, *Lappen,* German; *Sengui,* blood, *Sanguis; Ania,* a year, *Annus;* but considering the remoteness of their situation, we can scarcely form any conclusion from the occurrence of these resemblances. Mr Rémusat has lately been appointed Professor of this language at Paris; but it will probably be difficult for him to render its study very popular in the midst of so busy a metropolis. Whether the language of the island of *Sagalien,* opposite to the mouth of the Amur, is a dialect of the Mantshuric, or totally distinct, and requiring to be classed with the insular languages, appears to be not yet sufficiently ascertained. The *Corean* has been supposed to be a mixture of Mantshuric and Chinese. the Coreans do not understand either of those languages when they are spoken; but this fact is perfectly compatible with the supposition

29. The *Tungusians,* in the east of Siberia, subject to the Chinese, speak a peculiar language, mixed with some Mongol; the Russian Vocabularies contain specimens of a variety of their dialects, besides those of the Tshapogirs on the Jenisei, and the Lamuti on the sea of Ochotsk, none of them particularly interesting or remarkable.

30. The languages belonging to the *Siberian* order occupy the principal part of the north of Asia between the mountainous Tartarian territory and the Frozen Sea. At the commencement of this order, we find a variety of inconsiderable nations in the neighbourhood of the confines of Europe and Asia, which have their distinct languages, probably formed in times comparatively modern, out of the fragments of others. They have almost all of them some Finnish words, but none a sufficient number to justify us in considering them as dialects of the Finnish language, although the people were very probably connected with the Fins, as neighbours, in the middle ages, on the banks of the Dwina and

elsewhere. The *Sirjänes*, in the government of Archangel, speak nearly the same language with the *Permians*, who are partly in the same government, and partly in that of Kasan. The *Wotiaks*, on the Wiatka, also in Kasan, have a dialect which seems to be intermediate between the Permian and the Tsheremissic. 31. The *Woguls*, situated on the Kama and the Irtish, afford specimens of several dialects in the Russian collection; they seem to have borrowed a few words from the Hungarian, and much more from the language of the *Ostiaks* (32), who are also divided into several races. 33. The *Tsheremisses*, situated on the Volga, in Kasan, have a little mixture of Turcotartarian. 34. The *Morduins*, on the Oka and Volga, have about one eighth of their language Finnish, and also some Turcotartarian words: the *Moktanic* is a dialect differing but slightly from the Morduin. 35. The *Teptjerai* are people paying no taxes, who originated from the relics of the Tartarokasanic kingdom in the sixteenth century, and who are said to speak a language peculiar to themselves. The arrangement of all these dialects must remain very imperfect; for want of a greater number of specimens of their peculiarities.

36. The *Samojedic* nations are situated north of the Tartars, by whom they may possibly have been driven into their present habitations. Their languages seem to have some affinity with the Caucasian and Lesgian dialects, and some of them with the Wogulic and Ostiak families; the specimens in the Comparative Vocabularies seem to have been multiplied somewhat too liberally. 37. The *Camashes* are situated on the right of the Jenisei; they are Shamanites or Buddists; their language seems to be a mixture of several others, and is divided into several very distinct dialects. The *Koibals* have been baptized; they have borrowed some words from the Turcotartarian family. The *Motors* are situated on the Tuba. 38. The Ostiaks on the river Jenisei afford us five specimens of languages totally different from those of the Ostiaks already mentioned, but nearly connected with each other, so that they may properly be called *Jeniseiostiaks*. 39. The *Jukagirs* or *Jukadshirs* are few in number; they are situated between the Jakuti and the Tshutshi; they have some Jakutish words mixed with their language, and some Tsheremissic. 40. The *Koriaks* and the *Tshutshi* occupy the north-easternmost point of Siberia; the proper Koriak is spoken on the bay of Penshin; the *Kolymic* on the river Kolyma, the *Tigilic* on the Tigil in Kamtshatka, and the *Karaginic* on the island Karaga; the Tshutshic has been considered as a dialect of the Koriak. 41. The *Kamtshatkans* are a little further south; the *Tigilic Kamtshatkan* is found, however, on the north of the Tigil; the *Srednish* to the west, on the Bolshaia, and the *Jozhnyshic* on the river Kamtshatka, and towards the South Cape. The languages of the neighbouring parts of America, according to Professor Vater, greatly resemble the Tshutshic.

The *Insular* order of the Tataric or Atactic class of languages must be understood as comprehending all the Asiatic islands east of Borneo. 42. The language of the *Curilees* is spoken not only in the principal of these islands, but also in Kamtshatka, about Cape Lopatka; but in some of the islands the Japanese is spoken. The *Japanese* derive themselves from the Chinese; but their language contradicts this opinion; they have evident traces of Mongol extraction or relationship. The amiable islanders of *Leu cheu* will long be remembered by the British public for the hospitality they showed to the Alceste and the Lyra; their language appears to be related to the Japanese, as might be expected from their situation. *Formosa* was conquered by the Dutch in 1620, but in 1661 it was taken from them by a Chinese pirate: the next year some books were printed in the Formosan language in Holland; the recapture of the island not being yet known there; in 1682, it was finally given up to the Chinese government. 47. The *Moluccan* is considered by Dr Leyden as an original language; that of Magindanao contains some Malayan, Moluccan, Tagalish, and Bugis. The *Tagalish* or *Gala* is the principal language of the *Philippines*, and almost as generally understood in that neighbourhood as the Malay and Hindustanee in other parts; it is allied to the Malayan and to the Javanese, and was probably derived in great measure from these languages; it also resembles in some measure the Bugis. The *Bissayish* is a ruder dialect of the Tagalish. The *Sulu* differs but little from these dialects, being derived from the same sources. The *Bugis* is the language of Celebes; it is supposed to be more ancient than the Javanese; it seems to contain no Sanscrit, but much Malay, Tagalish, and Javanese, and some of the old Ternate or Moluccan; it is written in a peculiar character, and some good poetry is found in it; there is a dialect called the *Mungharar*. The *Bima* somewhat resembles this dialect; it is spoken in the eastern parts of Sumbawa, and the western of Endé or Flores; it is written either in the Bugis or the Malay character; it seems to have a distant resemblance to the language of Orissa: the dialect of *Sumbawa* exhibits some slight variations. A few single words, as *Matta*, the eye, and *Matte*, death, are found to coincide in almost all the islands of the *Pacific Ocean;* the languages of which, notwithstanding their immense distances, seem to differ less than those of the inhabitants of some very small continental tracts; and they might probably be divided into a few well defined families, if our knowledge of them were more complete. The resemblance of *Matte* to the Arabian *Mot*, and the Latin *Mactare*, is probably accidental.

The number of the AFRICAN languages is supposed to amount to 100 or 150, and as many as 70 or 80 of them have been distinguished with tolerable accuracy. The population of Africa seems to have been derived from Arabia, and, as some critics think, rather from the southern than from the northern parts; a great number of its present inhabitants are negros, but these cannot be distinguished from the rest by any infallible criterion. The account given by Ptolemy of the interior part of the country appears to be wonderfully accurate and extensive; although some of his measures seem to be erroneous, and not sufficiently reconcileable with the truth, even by adopting Major Rennell's hypothesis respecting them. It is however remarkable that Pto-

Languages. lemy followed Hipparchus in extending the eastern coast of Africa to the Ganges, although more correct ideas of its form had been entertained at Alexandria before his time.

The *Egyptians* demand the priority, in treating of the inhabitants of Africa, from their early connexion with ancient history, both sacred and profane. It is observable that the representations of the old Egyptians have countenances more or less approaching to the negro physiognomy, though the dry bones of the skeleton have that character somewhat less decidedly than they must have had when clothed with the thick lips and flattish noses of the generality of the representations; at the same time there are sculptures of great antiquity, which exhibit features not unlike those of correct Grecian or Roman beauty; and others have a considerable resemblance to the Arabian nation; at present the people of middle Africa, in general, are more or less like negros, but they are somewhat less dark, and their noses and lips are less peculiar; the women sometimes screamed if Burckhardt made his appearance on a sudden, and called him the Devil, because he was white. The Egyptians are supposed by some writers to have received their civilization from Ethiopia; but there are at present no traces of the remains of high civilization further south than Nubia, except a few scattered monuments about Axum, of no great antiquity. The Egyptians were first called Copts by the Saracens, and their language has been commonly distinguished by the appellation *Coptic*, that is, as written in characters which are principally Greek, and frequently intermixed with a number of pure Greek words; but not a single fragment of Coptic has yet been discovered in this form that is earlier than the establishment of Christianity in Egypt; and it seems probable that the character was introduced by the early Christians at the time of the translation of the Scriptures into Coptic, which is certainly of very high antiquity. The Greek authors frequently mention an Egyptian alphabet of twenty five letters; but no traces of any such alphabet is found in the multitudinous inscriptions or manuscripts that have been preserved by the exertions of the numerous and adventurous travellers who have lately visited the country. (See the article Egypt, of this *Supplement.*) The Greek words mixed with the Coptic are not considered by the grammarians as incorporated with the language, nor are they admitted into the dictionaries. The genuine language bears very evident marks of great antiquity; its construction is simple and often awkward; and a great number of its words are monosyllables. We have positive evidence of its having remained unaltered, from the time of Herodotus, Plutarch, and other Greek authors, and it affords us the etymology of the name of Moses, and of some other words mentioned in the Scriptures. It exhibits a few coincidences with other ancient languages, but not enough to enable us to consider it either as the offspring or the parent of any of them, except that it gives us something like an explanation of the meaning of some of the Greek particles. Out of 114 original Egyptian words, which are enumerated by the Quarterly Reviewer, in his account of Mr. Townsend's work, there are fifty two that resemble the Greek, twenty seven the German and English, eighteen the Hebrew, three the Syriac, two the Arabic, two the Sanscrit, one the Sclavonian, and one the Cantabrian. It is, however, probable, that a person more intimately acquainted with the languages of the Arabian family would have been able to find a much greater number of coincidences, since nations, which had so much intercourse as the Jews and the Egyptians, could scarcely fail to have many words in common, even if their languages had been at first completely different; and probably many of the Arabic roots, which are not Hebrew, may be found in the Egyptian. To the Cantabrian word inserted in this enumeration, Dr Young has added five others, in his late essay, already quoted, the whole six being *Berria*, new; *Ora*, a dog; *Guchi*, little; *Oguia*, bread: "Otsoa," a wolf, whence the Spanish *Onza*; and *Shashpi*, seven: in Coptic, *Beri*, new; *Uhor*, a dog; *Kudshi*, little; *Oik*, bread; *Uonsh*, a wolf; and *Shashf*, seven; whence he infers that "if we consider these words as sufficiently identical to admit of our calculating upon them, the chances will be more than a thousand to one that, at some very remote period, an Egyptian colony established itself in Spain; for none of the languages of the neighbouring nations retain any traces of having been the medium through which these words have been conveyed. On the other hand," he continues, "if we adopted the opinions of a late learned antiquary," General Vallancey, "the probability would be still incomparably greater, that Ireland was originally peopled from the same mother country; since he has collected more than one hundred words, which are certainly Egyptian, and which he considers as bearing the same sense in Irish; but the relation, which he has magnified into identity, appears in general to be that of a very faint resemblance; and this is precisely an instance of a case in which it would be deceiving ourselves to attempt to reduce the matter to a calculation." It may, indeed, be imagined that the Egyptian dominions may formerly have extended to the Straits of Gibraltar, and that Spain may have derived a part of its population from this part of Africa, which approaches so near to it; but it could scarcely have happened that no traces of Egyptian monuments should ever have been found at any distance from the Nile, if that active people had really occupied any considerable portion of the neighbouring continent. The word *Chemistry*, in Greek *Chemia*, is well known to be derived from the Egyptian; it has successively been compared, by the Quarterly Reviewer, to *Chim* or *Chem*, heat; and to *Chem*, secret; the latter is the more probable origin of the two; and a third etymon might be found, if it were required, in the word *Dshem*, or *Ghem*, to *find*, or *Invention*. The Coptic language has been nearly extinct for about two centuries; but the service has been read in Coptic much more lately in some of the churches; though it has now been almost entirely superseded by the Arabic. The proper Coptic, or Memphitic, which was the dialect of Lower Egypt, is supposed, from a word quoted by Herodotus, to be the most ancient; the Sahidic or Thebaic of Upper Egypt was probably preserved for a longer time, especially in some of the monasteries; Languages.

there is a separate version of the principal part of the *Bible* in this dialect, fragments of which have been published by Mingarelli and Woide; a third dialect, much resembling the Thebaic, is commonly called the Bashmuric, and a fourth, the Oasitic, has been partially made known by Mr Quatremere de Quincy. The Egyptians have left no traces of their language among the people who at present occupy the countries that they inhabited; the Nubian vocabularies collected by Burckhardt contain no Coptic words; the people are of different Arab races, but have acquired peculiar dialects, probably mixed with those of the neighbouring negro nations, of several of which we find specimens in Mr Salt's *Voyage to Abyssinia*. But one of the most learned, as well as the most adventurous and industrious of modern travellers, has remarked some coincidences between the old Egyptian language and that of the Barabras, who are neighbours of the Nubians, and extend to the confluence of the Tacazze and the Nile. The Geez and Amharic have already been mentioned as descendants of the Arabian family; they seem to have introduced some traces of this extraction into several of the neighbouring dialects, probably by the translations of the Scriptures, or by the use of the Koran. Professor Vater has taken some pains to prove that the language of Amhara, the Camara of Agatharchides, is wholly independent of the Ethiopic and Arabian; but in this he appears to be mistaken. It exhibits some slight resemblance to the Sanscrit, in a few instances; thus, *Tshegure* is hair, in Sanscrit, *Tshicura*. Macrizi tells us, that there are, in the whole, fifty Abyssinian dialects; but he has probably exaggerated their number. We have obtained more authentic information respecting them from the collections of Bruce, and of his editor, Murray, and still more lately from Dr Seetzen and Mr Salt. Of the Mek of Dungola, the representative of a long race of the Christian Kings of Nubia, little is now known, except that he is in a great measure dependant on the King of Sennaar on the one hand, and has been expelled from a part of his territories by the Mamelukes, on the other. Of the Agows and the Gafats, neighbours of the Abyssinians, and situated on the Bahr el Azrek, as well as the Jewish Falashas, who are scattered over the country, especially in Dembea, we have read much in the historical romances of Mr Bruce, which certainly give a faithful picture of the countries to which they relate, notwithstanding some unaccountable inaccuracies with respect to the personal adventures of the author.

The north of Africa is occupied by inhabitants not much differing in appearance from the Arabs; its three principal divisions are the coast, the country of wild beasts, and the desert. The later Arabs have expelled the earlier Africans from the first division, and partly from the second; the *Berbers* occupy the third, inhabiting principally the Oases, or cultivable islands, scattered through the desert, from Mount Atlas to Egypt, and speaking, as Horneman first ascertained, the same language throughout this vast extent. They were first well described by Leo Africanus; they are probably the remains of the Mauritanians, Numidians, Gætulians, and Garamatians; there is no foundation whatever for the opinion of some modern authors of celebrity, that their language is derived from the Punic; we even find, from Sallust, that the Numidian language differed from the Carthaginian, and from Valerius Maximus, that it was written in a peculiar character, perhaps the same with that which is found in the inscriptions from Lebeda, now in the court of the British Museum. The language of the *Canaries* considerably resembles the Berber; thus, Milk is *Acho* in Berber, and *Aho* in the Canaries. These islands were discovered in 1330, and afterwards conquered, with some difficulty, by the Spaniards; the inhabitants were a fine race of men, and lived in comfort and tranquillity; and they still present some traces of their original character and condition.

The country between the desert Zaara and the Niger is inhabited by a race of people who have a great resemblance to negros, but are somewhat different from them. In the east are those of *Sudan* or *Afnu*, and *Begirma*; in the west the *Fulahs*; the *Phellatas* are a branch of these, extending considerably to the north east, with a mixture of negros.

Of the languages of the negros, strictly so called, many interesting specimens have been collected by the zeal of the evangelical missionaries in the Caribbee Islands, and published by *Oldendorp*, in his Account of the mission; but they do not afford us sufficient materials to enable us to trace any extensive connexions or dependencies among their multifarious dialects.

There are some points of coincidence between the language of *Madagascar* and those of the Malays, the Philippine islanders, the *Beetjuana* Caffres, and the *Corana* Hottentots; there are also a few words, in many of the African dialects, borrowed from the modern Arabic, not, as Court de Gebelin would persuade us, from the Phœnician: nor can any other of the affinities be very distinctly established.

The *Caffres* have little of the negro character, except the black colour, and less of this as they become more remote from the equator; they are supposed to extend across the whole of Africa, immediately north of the Hottentots, as far as Benguela and Quiloa. The *Hottentots*, with their neighbours the *Bosjemen*, speak different dialects of the same singular language, in different parts of their country. Of that of the *Dammaras*, little or nothing is known. Lichtenstein has classed them as Hottentots; but Barrow, who was better acquainted with them, considers them as Caffres.

(Gesner, *Mithridates, de Differentiis Linguarum*, 8. Zurich, 1555.—Megiser, *Specimen XL. Linguarum*, 1592.—Duret, *Thrésor de l'Histoire des Langues*, 4. —Lüdeken (Muller), *Specimina Linguarum*, Berl. 1680.—Chamberlayne, *Oratio Dominica*, Amst. 1715. —Schultz, *Orientalischer und Occidentalischer Sprachmeister*, Leipz. 1748.—Hervas, *Saggio*. Hervas, *Idea dell' Universo*, 4. Cesenn. 1778–87, Vol. XVII.–XXI. *Vocabularia Comparativa*, 2 Vols. 4to, Petersburgh, 1787, 4 Vols. 1790.—Bergmann, *Specimina*, Ruien, 1789.—Marsden's *Catalogue of Dictionaries and Grammars*, 1796.—Marcel, *Oratio Dominica*, Paris, 1805.—Adelung und Vater, *Mithridates, oder allgemeine Sprachkunde*, 4 Vols. 8vo, Berlin, 1806–17.—Le Pileur, *Tableaux Synoptiques de mots simi-*

Languages || Leicestershire.

laires, 8vo, Paris and Amst. 1812.—Jamieson's *Hermes Scythicus*, 8vo, Edin. 1814.—Townsend's *Character of Moses*, Vol. II. 4to, Bath, 1815.—Leyden, *Asiatic Researches*, X.—*Brief View of the Baptist Missions and Translations*, 8vo, Lond. 1815.—Vater, *Index Linguarum totius Orbis*, 8vo, Berl. 1815.—Vater, *Proben Deutscher Mundarten*; Seetzens *Nachlass*, 8vo, Leipz. 1816.—Arndt, *Ursprung und verwandtschaft der Europäischen Sprachen*, 8vo, Frankfort, 1818, compared with the Russian. *Volney sur l'Etude Philosophique des Langues*, 2d edit. 8vo, Paris, 1820.—Laments that he has not the *happiness* to understand German.—*Quarterly Review*, No. XIX. 8vo, Lond. 1813, XXVII. 1816.)

(I. J.)

LEICESTERSHIRE, an English inland county. It is bounded on the north by Nottinghamshire and Derbyshire; on the west by the latter county and Warwickshire: on the south by Northamptonshire, and on the east by Rutlandshire and Lincolnshire. It is of a triangular form, and few of its limits are marked by nature, as the rivers Soar and Trent form only a part of its northern boundary, and the river Anker a smaller portion of its western frontier. Its greatest length, from north to south, is 45 miles, and its greatest breadth, from east to west, 35 miles. Its area contains 816 square miles.

Extent; Bounds.

It is divided into six hundreds, containing 10 towns, 196 parishes, and 30,649 dwelling-houses. By the census of 1811, the number of inhabitants appeared to be 150,419, viz. 73,366 males, and 77,058 females. The deaths, the year preceding, were, 1366 males, and 1370 females. The baptisms of the same year were 2034 males, and 2024 females; the marriages, 1206. The number of families was 31,480; those employed in agriculture were 11,700; those in trade and manufactures 17,027, and those of neither description 2753.

The towns whose inhabitants exceed 1500 are the following:

Towns.	Houses.	Inhabitants.
Leicester, -	4,683	23,146
Hinckley, - -	1,123	6,058
Loughborough,	1,140	5,400
Ashby-de-la-Zouch,	647	3,141
Sheepshead, -	547	3,026
Donnington Castle,	493	2,308
Melton-Mowbray,	422	2,145
Wigston Magna,	388	1,901
Lutterworth,	425	1,845
Market Harborough,	342	1,704
Kegworth. -	313	1,550
Earl Shilton, -	310	1,533
Mount Sorrel, -	281	1,502

Face of the Country.

The county of Leicester may be described generally as a level district, whose undulations are very gentle, and exhibiting but few interesting prospects. The exceptions to this remark are the Charnwood Hills, on the northern part of the county, which rise in an insulated mass, and from the summit of which the rest of the county appears extended in a well-wooded but even surface under the feet. The most lofty prominence of this range of hills (commonly denominated the *Forest*, though it is is destitute of trees) is Bardonhill, whose top is 850 feet above the level of the sea. The vale of Belvoir, in which the castle of the Duke of Rutland stands, displays much beauty of a soft, rather than a romantic and picturesque character.

Rivers and Canals.

None of the rivers of this county are considerable streams, nor any of them calculated for the conveyance of commodities except the Soar, for a short distance, but they are abundant, and contribute to increase the beauty and fertility of the district. Their names are, the Anker, Avon, Blackbrook, Deane, Eye, Scalford, Sence, Snite, Soar, Swift, Trent, Willand, and Wreke. The intercourse of the county both in its own different districts and with the surrounding parts of the kingdom, is amply provided for by several navigable canals. One of these connects the town of Leicester with the Grand Junction Canal, in Northamptonshire; another communicates by Loughborough with the river Trent; another from the coal mines near Ashby-de-la-Zouch, passes by Hinckley, and proceeds into Warwickshire; and one is designed to connect Melton-Mowbray with the centre of Rutlandshire.

Soil and Agricultural Productions.

Though the soil is various, yet, in general, it may be classed under the denominations of either clay or loam, for there are very few portions of it that are calcareous, sandy, or gravelly. The best soil is on the hills, and generally the vallies are a cold clay, very wet in the winter, and with the turf so tender as scarcely to bear the treading of sheep in that season. The soil is naturally productive of the best and most abundant crops of grass, and better fitted for feeding cattle than for arable culture. In consequence of this quality, a very small portion is under the plough, but those parts produce most excellent wheat, oats, and beans; the latter have great celebrity. There are few open fields now remaining, and the quantity of waste land is very small. The productions of the soil are principally from the sheep and cows. Mr Bakewell, whose fame in improving the breeds of all cattle is generally known, has been the means of stocking this county first, and afterwards many other parts of England, with a race of sheep produced by various crosses, that by many farmers is now preferred to every other, and universally known by the name of the *new Leicesters*. They unite perfect symmetry of shape with the smallest possible quantity of bone and offal, and their wool is both fine and abundant. The horned cattle were, in like manner, improved by the lessons of this skilful breeder; and no part of England exceeds Leicestershire either in its beef or in the produce of the dairy. The cheese commonly made is in great request through all the north of England, and the kind called Stilton, from having been first sold in that town, though made near Melton-Mowbray, is perhaps the richest in the world.

Stilton Cheese.

The process of making it was long kept a secret in a few villages, but is now universally known. Its richness arises from one-half the milk being skimmed, and the cream taken from that added to the other milk, so that the cheese have double the usual quantity of cream in their composition. Bakewell improved, also, the breed of horses to a great extent. In this line there was less room for any extraordinary progress; but his black horses, of the cart kind, originating principally from mares which he brought from Flanders, enabled him to introduce the method of ploughing with two horses abreast, by which much labour in agriculture is saved.

Manufactures.

The manufacture of most eminence in this county is that of Hosiery, which gives employment more or less constant to two-thirds of its inhabitants. The quantity of stockings made here is prodigious, and supplies the greater part of the British dominions, as well as many other parts of the world, with those of an inferior and middling quality. The first frames were invented about 1590, but the first introduced in Leicestershire was used at Hinckley, in 1640. Since that period, many improvements in the machinery of them have been made. At each step in advance, the apprehension of diminishing the labour has occasioned riots and tumults among the workmen, which have been continued to the present time, and recently has embodied them under the denomination of *Luddites*, to the terror of the peaceful inhabitants, some of whom have transferred their capitals and machinery to less turbulent districts. The only other manufactures of consideration are, an extensive one of cotton-spinning and weaving, at Loughborough, and some small ones, of stuffs, at Market Harborough.

Minerals.

In the north-west part of the county there are extensive mines of valuable coal, which supply the inhabitants of the surrounding districts. With them terminate the mines in the direction of the German Ocean to the southward. At Bredon, on the confines, the singular rock, called Bredon Hill, is composed of a most valuable kind of limestone, which forms an excellent cement in water, and which was used for building the pier of Ramsgate.

Antiquities.

The Roman roads are still visible in many parts of the county, though in many instances they have been covered by the more recent highways. The Watling Street road, the Fossway, and the Via Davana, traversed the county, and have been traced with great accuracy by antiquarians. At Radcliffe, on the Wreke, is an ancient tumulus, generally attributed to the Celts, 350 feet long, and 120 broad. At Leicester, which was a Roman station, are still visible the remains of the architecture of that people, in what is called the Jewry wall, consisting of a mass of stones, brick work, and dilapidated arches, built in alternate courses of brick in three layers, and of stone. Near the town is the vestige of a British Cursus, according to some antiquarians, or of a Roman camp, according to others. At different and distant periods a great number of coins have been discovered, with the names of Titus, Trajan, Dioclesian, Constantine, Constantius, Hadrian, and other Roman emperors. Other Roman antiquities have been found at Rothley, at Wanlip, at Market Harborough, at Burrow, and at Cathorpe. The Gothic remains are considerable; those of the Abbey of Leicester, of the Nunnery of Grace Dieu, Ulvestoft Priory, Laund Priory, the Castle of Ashby-de-la-Zouch, the churches of Hinckley and Melton-Mowbray, and the chapel of Market Harborough, all reward the inspection of the antiquarian.

Historical Notices.

In the church of Lutherworth, the pulpit and part of the vestments of the great reformer Wickliffe are still preserved. He was buried there in 1387; but, in 1428, his bones were taken up and burnt, and the ashes thrown into the river, by order of the Council of Sienna. Leicestershire has been the scene of two great military events, which have been the means of transferring the government of England. The first the battle of Bosworth, which terminated the reign and life of Richard III. in 1485, and the other the battle of Naseby in 1645, which led to the death of Charles I., and the subsequent elevation of Oliver Cromwell.

Leicestershire returns but four members to Parliament, viz. two for the county, and two for the borough of Leicester.

The noblemen and gentlemen's seats are very numerous: the most remarkable are, Belvoir Castle, Duke of Rutland; Beaumanoir Park, W. Herrick, Esq.; Buckminster, Sir William Manners; Staunton Harold, Lord Ferrers; Kirkby Park, Sir R. Milbank; Normanton Hall, George Pochin, Esq.; Rothley Temple, T. Babbington, Esq.; Stapleford, Earl of Harborough; Stoughton Grange, G. A. L. Keck, Esq.; Donnington Park, Marquis Hastings; Gospal Hall, Honourable R. Curzon; Stewards Hay, Earl of Stamford.

See Nicholls's *History of Leicestershire*; and *Parliamentary Population Papers*. (W. W.)

Situation and Extent.

LEITRIM is a county in Ireland, in the province of Connaught, bounded on the north by the bay of Donegal and the county of Fermanagh, on the east and south-east by Cavan and Longford, and on the south and west by Roscommon and Sligo. It is about 58 English miles long, and from 7 to 20 broad, and contains 601 English square miles, or 386,560 English acres, divided into five baronies, and seventeen parishes. Half this area or more consists of bog, waste, and water. The centre of the county is in north latitude 55°, and west longitude 7°.

Surface, &c.

The river Shannon, which enters Leitrim on the north east from Cavan, about five miles from its source, and soon after flows into Lough Allen, forms, after issuing from that lake on the south, the boundary with Roscommon, on the south-west, till it leaves this county at the village of Rusky. From Carrick on Shannon to Rusky the country is well wooded, fertile, and exceedingly pleasant; but from the southern side of Lough Allen to the northern boundaries, throughout its whole breadth, the greater part of the surface is occupied with mountains, and presents, though not without several exceptions, a very rugged and sterile appearance. The Shannon is the only river of any note; another, the Abhain-Naille, is remarkable for having its source in the lake Killowmawn, situated on the summit of a mountain, called Leacka, into which no streams flow

Leitrim.

The principal lake is Lough Allen, near the middle of the western boundary, about nine miles long, and seven miles broad. Lough Melvyn and Lough Gill, though much smaller, deserve to be noticed for the beauty of the scenery on their banks, and the former for its wooded islands and ruins. In these lakes, and also in the Shannon and most of the rivulets, various sorts of fish, the perch in particular, are in great abundance.

There are large tracts of a dark fertile soil incumbent on limestone in the low grounds, but the hills are for the most part covered with a coarse unproductive clay mixed with gravel, and very retentive of water. Below this clay, slate of different colours sometimes occurs. Ironstone, in some places alternating with limestone, is very common; and it was formerly worked to some extent. Coal is found in the mountain Sliebh-an-Erin, on the east side of Lough Allen, and has been raised in quantities for some years, but it is not of a good quality, and is employed only in founderies. Pipe-clay and ochre appear in the beds of the rivulets that descend from this mountain. Lead and copper are known to exist in several places; and there is a great variety of clays and marls. Mineral springs, both chalybeate and sulphureous, are not unfrequent, and have been used with very beneficial effects.

Minerals.

About the beginning of the eighteenth century, Leitrim is said to have been almost a continued forest. There is now little wood in it, and no considerable plantations. The proprietors, however, have of late paid some attention to this method of improvement, and several large nurseries have been established for the sale of forest and other trees.

Estates and Farms.

This county is in general divided into large estates, and nearly all the great proprietors are absentees. The leases are commonly for three lives or thirty-one years. Agriculture is here in a very low state. The tillage farms are small, seldom exceeding fifty or sixty acres, and these are almost always subdivided among a number of tenants. The plough is very little used. The most common implement is the loy, a kind of spade eighteen inches long, about four inches broad at the bottom, and five or six inches at the top, where it is furnished with a wooden handle about five feet long. The first two crops are potatoes, which are followed by flax, and then oats for one or more years. Clovers and other green crops are unknown in the practice of the tenantry. The county raises grain and potatoes sufficient for its own consumption, but exports very little of either. Its cattle have been much improved by the introduction of English breeds, to which some of those now bred and reared in it are said to be not inferior. There are no considerable dairies, yet a good deal of butter is made throughout the district, and some of this is sent to the market of Sligo. The sheep are of the native race, small, and but few in number.

Population.

In 1802, the number of families multiplied by five, gave a population of 76,630, in which, according to Wakefield, the Catholics are as thirty to one. The principal towns are Carrick on Shannon, Carrigallen, Mohill, Ballinamore, and Manor Hamilton, none of which contains more than a few hundred inhabitants. Leitrim, from which the county takes its name, has been for many years of still less importance, though it is pleasantly situated on the Shannon. There are several bleachfields, and some coarse potteries; and a number of people are employed in weaving. But the linen made here, as well as the coarse woollen goods, is chiefly for the use of the inhabitants themselves. The houses of the lower classes are of the worst description; even the more recently erected farm buildings, including a little barn and cow-house, do not cost more than L.10 or L.12. Turf is their only fuel, and potatoes and oaten bread the chief articles of food, meat being used on extraordinary occasions only; but the people are said to be comfortably clothed. In 1802, wages were only from 4d. to 6d. a-day for cottars, and 6½d. with breakfast and dinner, for occasional labourers, and these rates have not been much altered since. The price of potatoes is from 1½d. to 3d., and of oatmeal from 1s to 1s. 9d. *per* stone. Even among the old people the English language is in general use. Leitrim county sends two members to Parliament. See Macparlan's *Agricultural Survey of Leitrim*, and the general works quoted under the former Irish counties. (A.)

Wages and Prices.

Leitrim ‖ Lemonnier.

LEMONNIER (PETER [CLAUDE] CHARLES), a diligent and accurate astronomer, born at Paris, 23d November 1715, was the son of Peter Lemonnier, of St Sever in Normandy.

His father was a professor of philosophy in the College d'Harcourt, and a member of the Academy of Sciences: he distinguished himself, as a teacher, by his activity in promoting the introduction of mathematical reasoning into the Cartesian philosophy. Under such auspices, the son might have enjoyed facilities for the cultivation of any of the sciences; but he soon showed a decided preference for astronomy, and began to be a practical observer before he was sixteen. In the month of November 1732, Mr Fouchy procured him the use of a mural quadrant of three feet radius, and he soon applied himself with diligence to the determination of the sun's greatest equation,—an investigation which he continued for many years; and in 1741, he found the equation to amount to $1^{\circ}\ 55'\ 31''$; a quantity differing only by $7''$ from Delambre's latest determination.

He presented to the Academy of Sciences, in 1735, an elaborate map of the moon, accompanied by some remarks; and in the month of April of the following year, before he was twenty-one years old, he was made a member of the Academy, in the character of Adjunct Geometrician. He continued to be a constant contributor to its *Memoirs* for more than fifty years. The winter of 1736 and 1737 he passed at Torneo, with Clairaut and Maupertuis, as a member of a committee appointed by the Academy for measuring a degree in Lapland, and he was not less zealous than any of his colleagues in the execution of that arduous undertaking.

He is considered as having effected, in conjunction with Lacaille, a complete reformation in the practical astronomy of France. He entered very early into correspondence with the English astronomers of the day; they had carried their instruments and modes of observation to a higher degree of per-

Lemonnier. fection than their neighbours; and Lemonnier was of great use to the science, in making known to his countrymen the practical methods of Flamsteed, and in introducing the instruments of Graham and Bird. In April 1739, he was made a Foreign member of the Royal Society of London, and for the last twelve or fourteen years of his life, he is said to have been the senior member of the Society. He was the first that introduced the effects of nutation, then lately discovered by Bradley, into the solar tables; and he complained bitterly of Lacaille's injustice, in not giving him due credit for the improvement.

The Duc de Noailles made him known to the King of France, who was fond of his company, and showed him many kindnesses; in 1742, he gave him apartments at the Capucins in the Rue St Honoré, where he continued to live till the Revolution: on another occasion, when he had taken great pains to fix an accurate meridian at St Sulpice, the king made him a present of 15,000 livres, which he expended in the purchase of instruments, as the greatest luxury that he was capable of enjoying.

The places of the stars, which he determined in 1740, served Lalande for the purpose of computing their proper motions, though they differed a little from the results of Bradley's observations. About 1746, he was much engaged in examining the inequalities of Saturn, produced by the attraction of Jupiter: and Euler employed his computations in the theory, which obtained a prize in 1748; each confirming the accuracy of the other. He continued to observe the moon, without intermission, for fifty years, though a small part only of his observations was published.

In the year 1748 he went to England, partly for the purpose of obtaining further information, from a personal acquaintance with the astronomers and opticians resident in London, and partly in order to observe the solar eclipse of that year, in a situation where it would be very nearly annular. He proceeded accordingly to Scotland with the Earl of Morton, accompanied by Short the optician, and they observed the eclipse together at Aberdour, an ancient residence of Lord Morton's in Fifeshire. They obtained their time from the College at Edinburgh, where there was a transit instrument, by means of the flash of a cannon fired from the castle at twelve, and another five minutes after. "The eclipse was so nearly annular, that at the nearest approach, the cusps seemed to want about one-seventh of the moon's circumference to be joined; yet a brown light was plainly observed, both by Lord Morton and myself," says Mr Short, "to proceed or stretch along the circumference of the moon, from each of the cusps, about one-third of the whole distance of the cusps from each cusp; and there remained about one-third of the whole distance of the cusps not enlightened by this brown light, so that we were for some time in suspense whether or not we were to have the eclipse annular with us. During the greatest darkness, the planet Venus was seen at Edinburgh, and other places, by a great number of people, but I did not hear of any other stars being seen. The darkness was not great, but the sky appeared of a faint languid colour." In fact, our mornings and evenings are always illuminated by a light, which Lemonnier. has acquired more or less of a red tinge in its oblique passage through the atmosphere; and when we have a similar light without the redness, the contrast between the sensation and the memory makes it appear "faint," that is, greenish or grey, instead of white. Mr Lemonnier was particularly anxious to measure the moon's diameter, which "he found 29′ 47½″," agreeing precisely with the computed diameter, and not requiring any correction for the supposed effects of irradiation. A similar remark was made by a very accurate practical astronomer in the eclipse of 1820.

In order to verify the position of his mural quadrant, which was of eight feet radius, and made by Bird, Lemonnier felt the advantage of having a moveable one to compare with it, and he procured a block of marble eight feet by six, and fifteen inches thick, turning on an axis, to which he fixed his smaller instrument, of five feet radius, in order to be able to reverse its position. He devoted a considerable portion of his time to the investigation of the laws of magnetism, and especially to the variation of the compass; and he endeavoured to ascertain the effect of the moon's influence on the winds, and on the atmosphere in general.

Lemonnier had long disputed the accuracy of the Parisian base, measured by Cassini and Maraldi, but he was at last convinced that his objections were groundless. He was originally a most zealous friend and patron of Lalande, but afterwards, having taken offence at some slight cause, he refused to see him for many years. In fact, he appears to have been somewhat obstinate and irritable; but he is said to have had genius, zeal, activity, and intelligence, as well as credit in the world, and reputation among men of science. He was a voluminous writer; he had much learning and sagacity, but he often wanted precision in his language and his reasoning. In November 1791, he had a paralytic attack, which terminated his scientific career, though he survived it till the 2d April 1799, when a second stroke carried him off, at Héril, near Baieux. He was made, in the mean time, one of the 144 original members of the National Institute, as a testimony to the merit of his past labours.

He had married, in 1763, Mlle. de Cussy, a lady of very respectable family in Normandy. He had three daughters; the first married Mr de Parfouru, who was an early victim of the Revolution; the second the celebrated Lagrange; and the third her uncle, Lemonnier the physician, who was also a man of considerable science, and a Member of the Royal Society of London.

From 1735 to 1790, there are very few volumes of the *Memoirs* of the Academy without one or more of Lemonnier's papers; but though not unimportant in the aggregate, they are somewhat uninteresting in the detail. They relate almost exclusively to astronomical observations: eclipses, occultations, appulses, oppositions, and conjunctions; solstices, longitudes and latitudes; with some accounts of astronomical instruments and apparatus. There are also some memoirs relating to the sun's equation and diameter, and on his place, as compared with

Lemonnier. Arcturus; on the motion of Saturn, and on his fifth satellite; on the expansion of wooden measures; on the transit of Venus, and on the diameter and the tables of that planet; on Euler's formula for parallax; on the variation of the needle; on lunar altitudes; on the tides; on horizontal refraction; on Saturn's ring, and on some currents of wind. He also published separately some extensive works, which acquired considerable celebrity.

1. The first was his *Histoire Céleste*, 4. 1741. Comprehending the interval from 1666 to 1685; and containing an account of a transit instrument of Graham's construction.

2. *Théorie des Comètes*, 8. 1743. Including a translation of Halley's work on comets; together with a method of computing the orbit from three observations.

3. *Institutions Astronomiques*, 4. 1746. An improved translation of Keill's Astronomy, which long continued to be the best elementary treatise in the French language, It contains also solar tables, and a variety of other additions derived from observation.

4. *Observations Astronomiques*, Part I. 1751, II. 1754, III. 1759, IV. 1775.

5. *A Letter on the Theory of the Winds*, in Halley's Tables, published by Chappe.

6. *Nouveau Zodiaque, reduit à 1755*, 8. Paris, 1755. Containing thirty-one pages of charts, much more complete than those of Senex, and superseded by some very late publications only.

7. *A History of Astronomy* in the *Traité d'Aberration* of Fontaine des Crutes.

8. *Observations pour la mesure du degré entre Paris et Amiens*, 8. 1757.

9. *Abrégé du Pilotage*, par Goubert, 4. 1766. With additions.

10. *Astronomie nautique lunaire*, 8. 1771.

11. *Exposition des moyens les plus faciles de résoudre plusieurs questions dans l'art de la navigation*, 8. 1772. Employing very generally a table of verse sines; and greatly recommending the use of Gunter's scale for nautical computations.

12. *Essai sur les marées*, 8. 1774. Particularly describing the effects of the tides at Mont St Michel, and on the neighbouring flat sands; including also some considerations on refraction, and on magnetism.

13. *Déscription et usage des principaux instrumens d'astronomie*, fol. 1774. As a part of the collection of *Arts et Métiers*.

14. *Atlas céleste de Flamsteed*, 4. 1776. Revised.

15. *Loïs du magnétisme*, 2 Parts, 8. 1776–8. With an elaborate chart.

16. *Traité de la construction de vaisseaux, par Chapman*, fol. 1779. From the Swedish. Said to be less perfect than the translation of Vial du Clairbois.

17. *Memoires concernant diverses questions d'astronomie et de physique*, 4 Parts, 4. 1781–4–6–8.

18. *De la correction introduite pour accourcir la ligne sèche du lock de dix-huit pieds*, 8. 1790.

19. *Lettre au sujet d'une éclipse*. Par. 1791. Together with some remarks on navigation, and on the currents of the South Seas; all apparently from the *Memoirs* of the Academy. The eclipse, which was observed as annular in China, should have been total, according to the computed distances of the luminaries concerned. (S. I.) Lemonnier ‖ Lewis.

LEWIS, is the name of an instrument which is indented into a large stone, and has a ring for the purpose of making fast a rope, in order to move the stone, or to act as a stay. It is called in Italian *Ulivella*, in French *La Louve*, in German *Stein Zang*. The lewis consists of three wedges of iron, forming, when put together, a dove-tail. The wedges are inserted into an equal and similar hollow dove-tail excavated in the stone. This hollow dove-tail is made exactly of the form and size of the lewis, and is a figure of six sides; a pair of vertical sides, which are opposite, equal, and parallel, and in form of truncated isosceles triangles; a pair of inclined sides, opposite equal rectangles, equally inclined to the axis of the hole, and not parallel. The top and base of the hole are rectangles parallel to each other, the base being longer than the top. The centre of the base and the centre of the top are in one vertical line. The form of the hole, therefore, is that of an inverted wedge, with the point cut off; it is like a cavity fitted to contain the inverted keystone of an arch. When the iron dove-tail called the lewis is inserted into this hollow dove-tail made in the stone, the ring at the smaller and upper end of the iron dove-tail serves for making fast a rope, for the purpose of raising the stone. The constitution of the substance of timber enables the workman to fix a rope to it by merely inserting a screw or a spike into the log; stone will not admit of these, and is made fast by the contrivance of the lewis. The lewis of the most useful form, and that which is used in Britain, is represented at fig. A, Plate XCIV.; *a* and *b* are two pieces of iron in form of inverted wedges. These pieces are inserted into a quadrangular hole which is made in the stone. The two opposite and shortest sides of the hole are dove-tailed, or, in other words, undercut, as represented at fig. B, which is a vertical section of the hole; *t* is the plan of the hole at top, *o* is the plan of the bottom of the hole. The hole, as represented in the figure, is five inches long at top. and six inches at bottom; the width is one inch, the depth seven inches. Sometimes the width is one and a half inch, and the depth four or five inches. The hole is made of such a size that the lewis fits exactly into it; *a'*, *c'*, *b'*, are transverse geometrical views of the pieces *a*, *c*, *b*: in the transverse views it is seen that the transverse sections of the parts of these pieces that enter the stone are of the same breadth from top to bottom. The piece *c* is represented with a perforation at top, for the purpose of taking out this piece more easily when the lewis is to be unshipped, but the lewis is usually made without this upper perforation. The pieces *a*, *b*, are first introduced into the hole, then is driven in *c*, which may either be a parallelopiped, or it may be a little thicker above, in form of a wedge; the ring *m* is then put on, and the bolt *g h* is passed through the holes of the ring and of the three pieces; the bolt enters at *g*, and forelocks at *h*. The tackle by which the stone is to be elevated is hooked on the ring *m*.

Lewis.

This ring, in cases where a rope is to be passed through it, is bound round with cord, to prevent the rope from being chaffed by the iron of the ring.

Piranesi has proposed and figured some other forms of this machine in his *Antichita di Roma*, but they do not appear to be so convenient as the lewis of the common form above described: one of the forms of lewis given by Piranesi is represented at fig. F. The two pieces which constitute the iron dove-tail open and shut by a joint; *n* is a bolt, which is put into the round hole at *p* after the instrument is inserted into the stone; this transverse bolt serves to keep the legs of the instrument spread out, so as to retain the form of the dove-tail. The lewis of the most usual form, represented at fig. A, and a lewis of another form, fig. G, are figured and described in Perrault's *Vitruvius*, lib. x. chap. 2, and in the *Theatrum Machinarum*, tab. XXXV. p. 111. In the lewis, fig. G, the iron dove-tail L has a ring at top, *r*, for receiving a rope; L is put into the dove-tailed hole in the stone, and then the two parallelopipedal iron bolts *e*, *u*, are put in on each side of the iron dove-tail; *e* and *u* are of equal thickness throughout. The top of the hole must not be less than the bottom of the piece L, to the end that L may enter into the hole. The ring must not project beyond the lines which form the prolongation of the inclined sides of the wedge L; for if the ring projected, the pieces *e*, *u*, could not be put into the hole. The hole must be formed so that the machine fit accurately into it.

Uses of the Lewis.

The lewis is used for raising large stones of several tons weight, in the building of harbours, bridges, and other solid fabrics, which, from the forces by which they are assailed, or on account of the long period they are designed to endure, require to be constructed of great masses of stone. Leupold, in his *Theatrum Machinarum*, mentions, that in many churches in Holland the pavement consists of large slabs of stone or marble, each of them the size of a grave, and covering a burying place; these slabs are laid close to one another, and join accurately, so that no lever or crow can be introduced into the joint to raise them; in each of the slabs there is a hole cut in form of a hollow dove-tail, and into this hole a lewis is introduced when occasion requires that the tomb should be opened.

In the construction of harbours, the lewis fixed in a large stone frequently serves to make fast the ropes which stay the cranes. The lewis is commonly used in the docks at London for fixing mooring-rings in the stone: the ring is easily removed when requisite, by unshipping the bolt of the lewis; for this and other reasons it is found more convenient to employ the lewis for fixing rings, than to run the ring-bolt into the stone with melted lead.

The largest stones that have been wrought and moved by the industry of man occur in the buildings of the ancient Egyptians, but it is not ascertained whether their architects employed the lewis.

Piranesi, in his *Antichita di Roma*, describes and figures lewis holes existing in the upper surface of the large stones of the tomb of Cæcilia Metella at Capo di Bove, near Rome. The *forcipes ferrei quorum dentes in saxa forata accommodantur*, mentioned by Vitruvius, lib. x. cap. 2, denote a machine in the form of nippers, used to effect the raising of stones in the same way as the lewis; but the words seem to indicate a machine different in form from the lewis. Piranesi also observed in some ancient unfinished buildings, stones which appeared to have been raised by another method, namely, by knobs left on the front and side of the stone, to which knobs the ropes were attached. The knobs were taken off when the building was finished.

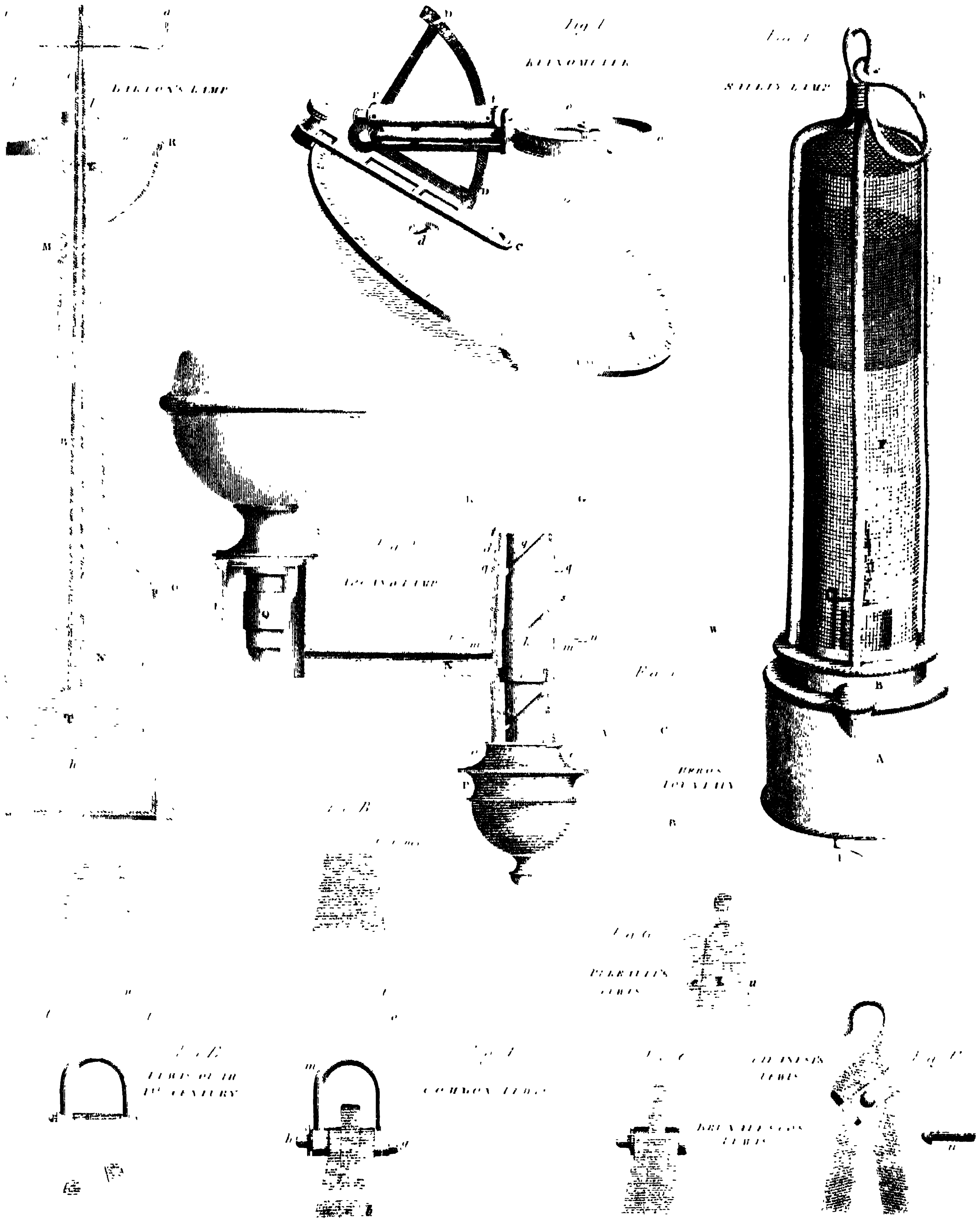
Lewis ‖ Leyden.

Vasari relates, in his Account of Brunalesco, that the use of the lewis was revived in Italy by that architect, who was well skilled in mechanics, and who constructed the cupola of the cathedral church of Santa Maria del Fiore at Florence, about the year 1430; the first great cupola that was built in Europe, and which Michael Angelo had in view when he designed the cupola of Saint Peter's. The lewis called Brunalesco's is represented at fig. C. Plate XCIV. Leo Baptista Alberti, a Florentine architect, who lived in 1440, in his *Treatise de Architectura*, mentions the lewis by the Latin name of *Impleola*: he describes the side wedges as having the figure of the letter D, and from that form the machine had its Italian name *Ulivella*, that is to say, Little Olive. Philander of Chatillon, in his *Commentary on Vitruvius*, published at Rome in 1544, gives a figure of the lewis used at Rome in his time, which resembles that used in England, and represented at figure A. In the *Archaeologia*, Vol. X. there is a description of holes observed in the crown of the keystones of the abbey church of Whitby, which was built about 1370, in the reign of Edward III. as is supposed. These holes appear to have been lewis holes; they are of the form of an inverted Y, as represented at fig. D, where *w* is the plan of the top of the hole, and *t t* the plan of the bottom; the lewis that fitted into these holes would resemble that represented at fig. E: these keystones at Whitby weigh about 1½ ton. (Y.)

LEYDEN (John), a celebrated linguist, antiquary, and poet, was born on the 8th of September 1775, at Denholm, a village on the banks of the Teviot, nearly opposite to Minto-house, in the parish of Cavers, and county of Roxburgh. His father was able to trace back his pedigree through a line of shepherds and husbandmen who had long occupied small farms on the estate of Douglas of Cavers, one of whom, Adam Ledan, in Little Cavers, a stern Presbyterian, had been denounced as a rebel in a royal proclamation in 1684. From his second to his sixteenth year, young Leyden lived with his parents in a retired cottage near the bottom of the "stormy Ruberslaw," where he was taught to read by his father's mother, and where he had no companions except the inmates of that rustic dwelling, and no books except the Bible, and such other volumes as are commonly possessed by the Scottish peasantry. His chief delight in the years of childhood was to listen to the tales of martial adventure and supernatural agency, recited by a blind uncle of his mother, and to read such works as the Metrical Histories of Bruce and Wallace, the Poems of Sir David Lindsay, and the *Arabian Nights' Entertainments*. In his tenth year he went first to school at Kirktown, a distance of two miles from his father's house, and

KLINOMETER. LAMPS. LEWIS

PLATE XCII



there, under three successive schoolmasters, he learned writing, arithmetic, and the elements of Latin grammar. After having spent three years in this manner, he was placed under the charge of Mr Duncan, a Cameronian minister at Denholm, and at the end of two years, not unprofitably employed in this small seminary, he entered the University of Edinburgh in November 1790. Mr Dalzel, then Professor of Greek, has repeatedly stated to the writer of this article, that he had seldom known any young man who at first appeared worse prepared for college, and who so speedily surmounted the disadvantages of imperfect tuition. He had accumulated a great stock of knowledge by a process of study peculiar to himself; but he had not thought it necessary to make himself master of grammatical rules; and, with all his strength and acuteness of mind, he at this time expressed his meaning in terms exceedingly awkward, and in a tone of voice so dissonant and loud as to set his fellow-students in a roar. He attended three winter sessions at the classes for languages and philosophy; applying with extraordinary ardour to every branch of inquiry connected with his academical studies, and to many other pursuits in which none of his instructors could have guided him. The vacations were generally passed in his native wilds among his own relations, with the exception of the summer 1792, when he acted as assistant in a village school at Whitebanklee, or Clovenfords, on Cadon Water, a mountain stream which falls into the Tweed, below Ashiesteel, on the skirts of Ettrick Forest. The charge of the school was left almost entirely to him; but the management of thirty boys and girls, from six to twelve years of age, appeared to be a task for which he possessed no manner of aptitude. Two of his pupils, who were learning Latin, looked up to him with deference and admiration; one of whom did not long survive him, and the other has held various appointments in the church and the universities; but the children in general were in a state of insubordination and tumult, which he endured with a degree of calmness, of which those who knew him in maturer life would have conceived him to be incapable. At this time his appearance was very prepossessing. He was ruddy and fair, with a frame rather delicate than robust, and an expression of great good nature and gentleness in his features.

In November 1793 he entered on the study of Divinity, Church History, and Hebrew, and passed through the usual course of four years' attendance, before he was proposed for trials as a licentiate or probationer of the Church of Scotland. Much of his attention was in the mean time devoted to historical research, to philology, to metaphysical speculations, and to natural history, and medicine. He was a member of various debating societies, in all of which he distinguished himself by the fluency and copiousness of his unpremeditated harangues, rather than by any graceful or polished eloquence. In one of these institutions he contracted an intimacy with Mr Henry Brougham, and with the late Dr Thomas Brown, and Mr Francis Horner, as well as with several other individuals who subsequently attained no inconsiderable distinction. About the same time he formed an acquaintance with some literary men farther advanced in life, as Mr Thomson, author of *Whist*, a poem, and Dr Robert Anderson, editor of the British Poets, and then supposed to be connected with the *Edinburgh Magazine*,—to which both Leyden and Mr Thomas Campbell, one of his youthful friends, contributed some of their earliest poetical essays.

When he had completed his theological education, he accompanied one or two pupils to St Andrew's in 1797, where he eagerly embraced the opportunity of attending the lectures of Dr Hunter, Professor of Humanity, and of Principal Hill, one of the Divinity Professors. He became also a member of the Theological Society, in which he delivered a number of discourses; one *On the Argument a priori for the Existence of God;* another *On Thanksgiving;* and two *On Regeneration.* He also engaged at almost every meeting in the discussion of some controverted point in divinity or philosophy; and it cannot be doubted that these discussions must often have been highly interesting, when such persons engaged in them as Dr Chalmers of Glasgow, whose speeches differed from most of the others in being generally read. Among the members at that period were Mr Duncan, now Professor of Mathematics at St Andrew's, and Mr John Campbell, now an eminent Counsellor at the English bar. In one respect Leyden felt and acknowledged his inferiority to the students at St Andrew's, namely, in having paid scarcely any attention to mathematics; a study for which he had so little turn, that by his own account he could never comprehend the definition of a straight line, owing to some metaphysical difficulty which nobody could solve to his satisfaction. He appears to have disliked the style of society in St Andrew's, where, however, he acquired more than one of his most valued friends, particularly Dr Hunter and another gentleman of high intellectual capacity, and scientific attainments. From the Presbytery of St Andrew's he received licence to preach in May 1798, and on this occasion he was much disgusted by a vulgar piece of waggery attempted to be practised at his expence by one of the members who told him, that, as he would be called upon to return thanks after dinner, it was expected that, according to established custom, he should give a specimen of his gifts in prayer, by using a form of words comprehending all the leading doctrines of the Christian faith. When the expected signal was given, Leyden stood up and began to pronounce such a prayer as might have been very suitable for the church; but after having proceeded at some length, and in a very sonorous voice, to enumerate the Divine attributes, he perceived that the company was astonished by this unusual exhibition, and sitting down abruptly in no very placid humour, he was more than half disposed to inflict personal chastisement on the offending individual, with whom he felt enraged, not merely on account of the indignity offered to himself, but for the indecent mockery of one of the solemnities of religion. About this time he returned to Edinburgh, where he frequently preached, not indeed so as to attract popular admiration, but in a manner which satisfied his numerous friends that he possessed a serious, as well as a philosophical mind. Hi

memory was retentive; but in conducting the devotions of a religious assembly, he was apt to be disconcerted by circumstances which would have given him no uneasiness if he had been addressing a learned society.

In the winter of 1798, he attended some of the medical classes, and at this period nearly lost his life, in consequence of his rash and unskilful treatment of a complaint which he believed to be an attack of colic. He swallowed a glass of spirits, in the expectation of receiving immediate relief; but the disorder proved to be *enteritis*, or inflammation of the intestines, and his constitution was so much weakened by venesection, blistering, and evacuations, that he never afterwards recovered the bloom of health. In addition to his duties as a tutor in a family, by which much of his time was engrossed, he had been engaged as a writer in the *New London Review*, and among other articles, contributed those on Horne Tooke's *Diversions of Purley*, on Dr Thomas Brown's *Observations on Zoonomia*, and on Vallancey's *Sanscrit History of Ireland.*

In the summer of 1799 he published a volume, entitled, *A Historical and Philosophical Sketch of the Discoveries and Settlements of the Europeans in Northern and Western Africa, at the Close of the Eighteenth Century.* This interesting piece (an octavo of 442 pages) was written in about six weeks, while the author was in bad health, and at a distance from books; but it exhibits proofs of extensive information, as well as of sound reflection. In the course of the autumn he engaged to publish *The Complaynt of Scotland*, a very rare anonymous work in the Scottish language, written early in the sixteenth century. It did not appear for nearly two years; but the preliminary dissertation, extending to nearly 300 pages, as well as the notes and glossary, indicated a compass of antiquarian lore, and a depth of research in various other unfrequented walks of erudition, which could not easily be rivalled. He also displayed great acuteness and ingenuity in attempting to prove, from internal evidence, that *The Complaynt* was the production of Sir David Lindsay.

Through Mr Richard Heber, to whom he was introduced by Mr Constable, he became acquainted with the most distinguished literary characters in Edinburgh, and among others, with Sir Walter Scott, who at this time was engaged in collecting the ancient traditionary rhymes published in the *Minstrelsy of the Scottish Border;* a collection which Leyden contributed largely to enrich, both by recovering unedited fragments of antiquity, and by communicating imitations written in the spirit and manner of the age of chivalry; as well as by furnishing materials for many of the notes, and particularly for the introduction to the tale of *Tamlane*, containing a learned dissertation on the Fairies of popular superstition.

In the year 1800, a plan was formed to establish him assistant and successor to the minister of his native parish, but it failed in consequence of the reluctance of the incumbent to agree to an arrangement on which the heritors and parishioners had set their hearts. Soon afterwards he was anxious to obtain the Professorship of Rhetoric and Belles Lettres in Edinburgh; but here also he was doomed to experience a disappointment.

About this time he made two successive tours through the Highlands, and collected much curious information, which was once intended for publication. He wrote several poems founded on the remains of Celtic story, two of which have been inserted in the *Border Minstrelsy*. In 1801 he also contributed to Lewis's *Tales of Wonder*.

The year 1802, the last which he spent in Scotland, was one of the busiest of his life. About the beginning of the year, he had carried through the press nearly half a volume of an enlarged *Account of the Progress of Discovery in Africa*. At the same time he engaged to conduct the *Scots Magazine* on an improved plan, and the volume for that year contains many articles furnished by him and by another eminent orientalist, the late Dr Alexander Murray. He was also employed in correcting the papers of the Highland Society for publication; and he edited a volume entitled, *Scottish Descriptive Poems, with some Illustrations of Scottish Literary Antiquities*, containing *Clyde*, by John Wilson, schoolmaster of Greenock,—*Albania*, addressed to the Genius of Scotland,—*The Day Estival*, by Alexander Hume, and *Poems*, by William Fowler. Early in this year, he offered to the African Society to explore the interior of those obscure and inhospitable regions in which so many Europeans have perished. His friends, alarmed at this apparently fatal resolution, became eager to obtain for him an Indian appointment, that might give him access to the treasures of Eastern learning, which his past attainments peculiarly qualified him to appreciate. Through the interest of Mr William Dundas, he was nominated Assistant Surgeon, and though it was privately stipulated, that, on his arrival in India, he was to devote himself chiefly to literary inquiries, he could not be permitted to go out as a passenger in that capacity, without producing a surgeon's diploma, and undergoing an examination before the Medical Board. He had attended many of the medical classes, but he had hitherto paid little attention to the practice of surgery, and it was therefore necessary to prepare himself for passing through the strict trials prescribed by the College of Surgeons. It reflects no slight credit on his capacity and application, that he accomplished this task within six months. He was not equally successful in procuring the degree of M. D. from the University of Edinburgh; but having gone to St Andrew's with certificates of his character and regular education, and having satisfied the Senatus Academicus at a private examination, as well as by reading several exercises prescribed to him in the Latin language, that degree was conferred on him there, on the 7th August 1802. While he was occupied in these unpoetical avocations, he continued at every interval of leisure to court the inspiration of the Muses, and he gave the finishing hand to the *Scenes of Infancy, descriptive of Teviotdale*, a poem which had been partly written before, but which was now enlivened by some of its most touching passages, and left for publication in the hands of Dr Thomas Brown, who, in the revision of the sheets, suppressed a number of verses

which the author conceived ought to have been retained.

Leyden spent the winter in London, having narrowly escaped the misfortune of sailing in the Hindostan, which was wrecked in its passage down the Thames. He sailed from Portsmouth in the Hugh Inglis, 7th April 1803, and soon after his arrival at Madras, was attached as Surgeon and Naturalist to the Commission for Surveying the Districts of the Mysore, in which capacity he was expected to turn his attention, not only to the natural history of the country, but to the manners, institutions, and language of the inhabitants. His constitution had nearly sunk under the labours to which he subjected himself, and he was under the necessity of removing to Prince of Wales's Island. Here he was befriended by the governor, Mr Dundas, and here too he procured the chief materials of the *Essay on the Languages and Literature of the Indo-Chinese Nations*, contained in the 10th volume of the *Asiatic Researches.*

He removed in 1806 from Prince of Wales's Island to Calcutta, where, through the favour of the Governor-General, Lord Minto, he was appointed one of the Professors in the Bengal College, from which station he was soon transferred to the office of a Judge of the Twenty-four Pergunnaks of Calcutta. The income attached to this charge was applied chiefly in purchasing manuscripts, and rewarding the native teachers whose instructions he solicited; and all his leisure hours were spent in the eager investigation of the languages, the laws and history of the East. In 1809 he was appointed a Commissioner of the Court of Requests in Calcutta, and in the end of the following year, having resigned this office, he obtained the office of Assay Master of the Mint. Soon afterwards he was required to attend Lord Minto upon the expedition to Java, that he might be employed in collecting information with respect to the learning and institutions of the native tribes, and that the Governor-General might enjoy the benefit of his services in negotiating with the local authorities, and in adjusting the future government of the country. After the British troops took possession of the city of Batavia, he ventured rashly into an ill-aired library, supposed to contain many Indian manuscripts,—and on leaving it, was immediately seized with a fever. which proved fatal three days after its accession, and a few days before the conquest of the island was completed. He died on the 21st August 1811.

A very high tribute to his memory was paid by Lord Minto, on occasion of a visitation of the College of Fort-William, after his Lordship's return from the conquest of Java.—"To speak of all that Dr Leyden had already performed, especially in the prosecution of Asiatic learning,—to compute the treasures which his incomparable genius, urging and sustaining his invincible powers of mental labour, presented the fair promise of acquiring and accumulating, would be to relate a history of the short, but memorable life he was allowed to live, and to expatiate into the yet more ample fields of inquiry of which he had projected the survey. I need not remind those who hear me of the zeal he had long nourished, for exploring the philology of the more eastern regions of Asia; of the first steps he had already made in the prosecution of that purpose, by the construction of vocabularies, but above all, by methodising and reducing into system the classification of the various languages spoken on the continent, intermediate between India and China; the various kingdoms and districts of which, as they recede from each of these extreme points, appear, with some relation to their local approximation, or to historical affinities, gradually to have blended and assimilated their respective languages into compound dialects, partaking of both the distinct and primitive tongues. To this just and authorized tribute to the literary merits of Dr Leyden, I must yet add a personal testimony, prompted by personal experience, to virtues of a higher class, neither connected with the talents and toils of a student, nor so uniformly the companions of learned reputation, as it would be natural perhaps to wish, and to expect. But I speak it in the presence of many who can attest it with myself, that, founder as he was of his own fortunes and reputation, and climbing by many laborious steps from the lowest stage of social life, to an eminence, which many cannot even maintain, though placed yet higher by their birth; no man, whatever his condition might be, ever possessed a mind so entirely exempt from every sordid passion, so negligent of fortune and all its grovelling pursuits,—in a word, so entirely disinterested,—nor ever owned a spirit more firmly and nobly independent. I speak of these things with some knowledge, and wish to record a competent testimony to the facts, that within my experience, Dr Leyden never, in any instance, solicited an object of personal interest, nor, as I believe, ever interrupted his higher pursuits, to waste a moment's thought on those minor cares. To this exemption from cupidity was allied every generous virtue worthy of those smiles of fortune which he disdained to court; and amongst many estimable features of his character, an ardent love of justice, and a vehement abhorrence of oppression, were not less prominent than the other higher qualities I have already described."

Sir John Malcolm bears testimony, in terms equally strong, to the purity, disinterestedness, and independence of his character, as well as to the indefatigable perseverance and ardour with which he devoted himself to literary and scientific acquirements; and, after adverting to some rather unpleasing oddities of manner, "How trivial," he adds, "do these appear, at a moment when we are lamenting the loss of such a rare combination of virtues, learning, and genius, as were concentrated in the late Dr Leyden."

See *Edinburgh Annual Register for* 1811; and *The Poetical Remains of the late Dr John Leyden*, with *Memoirs of his Life*, by the Rev. James Morton. 8vo. London, 1819. (C. C. C.)

LIBERTY OF THE PRESS.

Liberty of the Press.

THE task of pointing out which of the acts capable of being committed by the press it would be expedient to prohibit under penalties, we trust will be found to be greatly diminished, by what we have already established in the articles GOVERNMENT and JURISPRUDENCE.

Nature and Objects of the Inquiry.

There is scarcely a right, for the violation of which, scarcely an operation of government, for the disturbance of which the press may not be employed as an instrument. The offences capable of being committed by the press are indeed nearly co-extensive with the whole field of delinquency.

It is not for that reason, however, necessary to give a separate definition for every such violation or disturbance, for that would be to write the penal code over; first describing the violation as produced in other cases, and then describing them anew for the case in which the press is the particular instrument.

If, for the prevention of the violation of rights, it were necessary to give a separate definition for every instrument which might be employed as a means of producing the violation, the penal code would be endless. In general, the *means* is an immaterial circumstance. The violation itself, and the degree of alarm which may attend, are the principal objects of attention. If a man is put in fear of his life, and robbed of his purse, it is of no consequence whether he is threatened with a pistol or a sword. In the definition of a theft, of a fraud, or a murder, it is not necessary to include an account of all the sorts of means by which these injuries may be perpetrated. It is sufficient if the injury itself is accurately described. The object is to prevent the injury, not merely when produced by one sort of means or another sort of means, but by any means.

From these illustrations it sufficiently appears, that if an accurate penal code were composed, defining the violations of rights, and disturbances of the operations of government, to which penalties were to be annexed, every offence capable of being committed by the press would be defined without mentioning its name. It is no less evident, that if we include in the term *libel*, as, to the great encouragement of confusion, is generally done, all the offences capable of being committed by the press, we include in the definition of libel all the definitions of the penal code.

As far as persons and property are concerned, the general definition of the acts by which rights are liable to be violated, has been held sufficient; and has been regarded as including not less the cases in which the instrumentality of the press has been employed, than those in which any other means have been employed to the same end. Nobody ever thought of a particular law for restraining the press on account of the cases in which it may have been rendered subservient to the perpetration of a murder or a theft. It is enough that a law is made to punish him who has been guilty of the murder or theft, whether he has employed the press or any thing else as the means for accomplishing his end.

Liberty of the Press.

There can be no doubt, however, that the press is an instrument peculiarly adapted for the commission of injuries against *reputation*, and for effecting disturbance to the operations of *government*, while it has no peculiar adaptation for the commission of other offences. Here, too, it is equally certain there is the greatest disposition to restrain the press within improper limits. It is demanded of us, therefore, upon this part of the subject, to enter into greater detail.

We are then to inquire, in the first place, what are the acts of the press with respect to *private reputation?* and next, which are the acts with respect to *government*, which it is desirable that punishment should be employed to restrain?

Offences of the Press with respect to Private Rights.

Agreeably to the principles which have been already considered in the article JURISPRUDENCE, no act can be regarded as an offence with respect to an individual, which is not a violation of some of his rights.

In considering the rights which ought to be established with respect to *reputation*, one proposition may be assumed, that every man should be considered as having a right to the character which he deserves; in other words, to be spoken of according to his actions.

In what manner the definition of this right, which would form a part of the civil code, should be expressed, is not now the question; but it is evident that no peculiar difficulty belongs to it. As words, not thoughts, are the object of legal cognizance, the right can only have respect to security against certain words;—words imputing to the individual actions which he has not performed, or a disposition to actions, of which disposition there is no evidence.

Suppose that one man has instituted a suit against another, for the offence of having violated, through the press, his right to all the reputation he deserves. In his ground of complaint he must affirm that the man has imputed to him either the performance of actions which he did not commit, or a disposition to certain actions, of which disposition no evidence can be given.

The words are produced; and the first question is, whether they do or do not impute the actions which, in the complaint or bill of accusation, they are alleged to impute?

It is to be observed, that they who oppose the attempt to define the offences, which, for shortness, we call the *offences of the press*, make use of such occasions as this to raise their objections. How, they ask, can all the forms of expression be defined, by which the imputation of such and such actions may be either more openly, or more covertly conveyed?

It is very evident that the question on such an occasion, whether the words do or do not impute such

Liberty of the Press.

or such actions, is a question of fact. The law says, that such and such actions shall not be imputed, defining the actions. Whether such and such a man has imputed such actions, either by one set of words or another, is a question of fact.

The law, when it said that such and such acts should not be imputed to a man, could not determine whether A, who is accused by B of having imputed to him one of these acts, did so or not. That is to be determined by evidence bearing upon the fact. One, and in general the main article of that evidence, are the words which have been used. What is the import of these words; or, which comes to the same thing, what is the degree of proof involved in them, is to be determined, as all questions respecting the weight of evidence are in each instance to be determined, by the tribunal before which the accusation is brought. The interpretation of words rests upon the same footing in this as in all other cases, that, for example, of a Will. The law determines that whatsoever disposition a man has made with respect to his property, shall take effect after his death. But whether A has left his manor of Dale to B, is a matter of fact to be determined by evidence applying to that particular fact; principally by that arising from the words of the will.

It may still be argued by persons who do not easily renounce an opinion to which they have once given their support, that even the actions, the interpretation of which, or that of the disposition to which the legislature means to prohibit, cannot be defined.

This, however, is a position which it is impossible long to maintain. Some actions it is hurtful, others it is not hurtful, to a man, if he is believed to have committed, or to have a disposition to commit them. Evidently it is by imputation of the first sort alone, that any right with respect to reputation can be infringed.

The acts which a man receives injury from being believed to have committed, or to be disposed to commit, are either those to which the law has annexed penalties, or those to which the penalties of public disrepute and dislike are annexed.

With respect to those acts to which the law has annexed penalties, as theft, murder, perjury, and so on, it will not be pretended that there is any difficulty; the law has already defined them, or ought to define them, and they may be included with perfect precision in a few words.

Those acts which it is hurtful to a man, solely on account of the disrepute and dislike which they produce, to have it believed that he has committed them, may also be with sufficient accuracy determined.

The ends to be attained by punishment are, reparation to the individual to whom injury has been done, and prevention of similar acts in future.

In the idea of all punishment, effectual reparation to the injured individual is a necessary and essential ingredient. Suppose, then, it were declared by the legislature, that the imputation falsely of all acts, hurtful to the person against whom the imputation is brought, by reason of the disrepute and dislike which attach to him by whom such acts are supposed to be committed, shall be punished at least by reparation to be made to the party injured; the word *hurtful* is to this purpose perfectly precise. It would remain with the complainant to show what kind and degree of injury he had received; which is a matter of fact, to be estimated in each instance from the evidence adduced, by the tribunal before which the question is brought. If the injury sustained is a pecuniary injury, the question coincides exactly with the question of damages, decided regularly, in English courts, as a question of fact by the jury.

Injuries of the kind which we are now considering can affect a man only in two ways; either, as stated above, by lessening the pecuniary value which he might otherwise have enjoyed; or, secondly, by lessening the marks of respect and affection which he would otherwise have received. What the loss is, in this latter instance, is also evidently a question of fact. It has nothing, therefore, to do with the legal definition of the offence, the business of the legislature. It is a question, which, like all other questions of fact, must of necessity be determined upon evidence by the tribunal before which it is brought. It is no doubt a question of delicacy, and considerable difficulty, because the evidence must often consist of very fine and minute circumstances, which can seldom be precisely ascertained. But this is not the only class of judicial questions, the determination of which depends upon such evidence as it is very difficult accurately to collect and to weigh.

What it is of greatest importance, on this occasion, to remark is, that all the difficulty lies in the matter of fact. There is no doubt or obscurity in the law, which says, that for whatsoever hurt a man has sustained through actions or dispositions falsely imputed to him, he shall receive compensation. Difficulties, however, arising either from the complexity of the matter of fact, or the obscurity of the evidence, no legislature enactments can prevent. These are committed to the skill and fidelity of the judge.

One question for the legislature we have not yet considered; and that is, the compensation which can be made to a man for the diminution of those marks of respect and affection which he would otherwise have received. Let us suppose that a soldier has been accused of cowardice, in such a manner as to create a general belief of the truth of the accusation; that a man of honour has been accused of mendacity, or of some of those irregular propensities to which the horror of the public is attached; it is evident that money is not an appropriate compensation for injuries thus received.

When a man, through the offence of another, has been deprived of a certain amount of money, or of money's worth, we say that he has received compensation, when he is placed in the same situation in which he would have been if the offence had not taken place.

According to this idea of compensation, a man, against whom an unfavourable opinion has been created by the act of another man, has received compensation, when he is placed in the same situation with regard to the opinion of those with whom he is connected, as if that act had not taken place. This,

Liberty of the Press.

therefore, is the object which it ought to be the endeavour of the legislature to effect.

One expedient is perfectly appropriate. It is, that the man who has falsely propagated an unfavourable opinion with respect to another, should be made to do whatever is in his power to remove the impression he has made. To this end, he should publish the sentence of the judge, declaring that the action, or disposition which he had imputed to the individual injured, he had imputed to him falsely. He should at least be made to publish it in every way in which he had published the imputation. Frequently a more extensive publication might be required.

In most cases, it will be allowed, that this much would suffice. It may, however, be affirmed, that often the impression would be too profoundly struck, to be effaced by a mere knowledge of the sentence of the judge. In such cases, something more in the way of compensation would be required. On this, it is of importance to be observed, that if the impression produced by an imputation, which, after solemn inquiry, the judge has declared to be false, should not, by that declaration, be completely effaced, it implies necessarily one of two things; either that the public have evidence of the truth of the accusation, which was not adduced to the judge, and then the remaining impression is not owing to the imputation which the judge has condemned, but to the evidence; or, secondly, that the public mind is in a state of gross ignorance and imbecility, capable of forming opinions, even on the clearest subjects, not only not according to evidence, but in opposition to it. If the public mind, however, is in such a deplorable condition, it is the fault of the legislature; and for the rectification of this evil, the best course undoubtedly is, to take effectual measures for the instruction of the people, which instruction would soon place them beyond the danger of such contemptible as well as mischievous delusions. In the mean time, if something more than the publication of the sentence of the judge were necessary to restore a man to that degree of consideration of which the false imputation had deprived him, governments have numerous ways of raising the consequence of individuals; and no legislature would be at a loss for a gradation of expedients suited to the scale of demand.

We have now illustrated that part of this question which regards compensation to the injured individual. It remains to inquire what is best to be done in this case, for the attainment of the other object of punishment, namely, the prevention of similar offences in time to come.

To devise a punishment sufficient to prevent an offence, is to provide a motive sufficient to counteract the motive which leads to the offence. We have hence to consider what are the motives by which men are incited to make false imputations on the characters of others.

These motives may be of three different sorts. A man may derive *pecuniary profit*, he may derive *comparative distinction*, or he may satisfy his desire of *vengeance*, by blackening the character of his neighbour.

Liberty of the Press.

In the case in which a man has by calumny wrongfully intercepted the pecuniary receipts of his neighbour, the obligation of making satisfaction to the party injured would, it is obvious, alone suffice, provided the machinery of the laws were sufficiently perfect, to render the execution of them certain. Seldom would any man calumniate his neighbour, for the sake of placing L.20 in his own pocket, if he were sure that next day, or next week, he would have to restore it, with all the profit which might have been made by the use of it, and with the disgrace besides of having committed an action which other men abhor.

Sometimes, however, a man may derive pecuniary profit from calumniating persons whom he has not by that means deprived of any pecuniary advantage; by the sale, for example, of a slanderous publication; when the satisfaction due to the individual may not be of a nature to counteract the motive which leads to the offence. The expedient in this case, also, is sufficiently obvious, and sufficiently simple. It is necessary to ascertain the whole of the gain which has been made by the offender, and to take it away from him. This, together with the satisfaction which he ought to make to the injured individual, would, if it were certain, create a surplus of motive to abstain from the injurious act.

In both of these cases, if the execution of the law is uncertain, an additional punishment may be necessary, sufficient to compensate for the chance of escape. The allowance to be made on this score must depend upon the imperfection of the laws; while one important fact is to be kept in remembrance, that as severity of punishment, beyond a certain point, is increased, certainty of execution is diminished. The true expedient, therefore, is to render the machinery of the laws so perfect, that the penalties which they denounce may always be sure of execution; and then hardly any thing beyond compensation to the individual, and the abstraction of any additional gain which might have been made by the propagation of slander, would be necessary to repress all offences against the reputation of others, to which the motive was constituted by pecuniary gain.

The two remaining cases are still more simple. If a man propagates a falsehood, for the sake of injuring the character of a man by whom his own consideration is eclipsed, it is only when he expects to obtain by that means a permanent advantage. If he knows that immediately the law will take its hold upon him; that he will be compelled to re-elevate the character of his neighbour, and to proclaim his own disgrace, he will see that, to attempt depressing the character of another man by calumny, is the very worst of all expedients, for giving a comparative elevation to his own. The same is the result in the case where vengeance constitutes the motive to injure the reputation of another. To render this proposition manifest, the most obvious illustration will suffice. No man, to gratify his malignity to another person, would kill his ox or his ass, provided he were sure that immediately he would be obliged to make him full satisfaction; and instead of injuring the man whom he hated, to injure only him-

self. No, the rudeness and inefficacy of the law, holding out a chance of escaping the duty of making reparation, is the sole origin and cause of all offences of this description; and if the law were placed in a state but approaching perfection, hardly any thing beside the obligation of making satisfaction would be necessary to repress the whole of this order of crimes.

We have now made considerable progress in this important inquiry. We have ascertained, we think, with sufficient evidence, all that is necessary to be done for preventing injuries to the reputation of individuals; provided the rights of reputation are, by the civil code, not made to extend beyond the boundaries of truth. Whether or not they ought to extend farther, and individuals ought to be protected from the disclosure of acts which they may have committed, is, we confess, a question highly worthy of solution; upon which, therefore, before we proceed to any of the subsequent topics, we shall offer the following reflections.

There can be no doubt that the feelings of the individual may be as painful, where actions of a disreputable nature are truly, as where they are falsely imputed to him. It is equally certain that no painful feelings ought to be wilfully excited in any man, where no good, sufficient to overbalance that evil, is its natural consequence.

We have already shown, that reputation is injured by the imputation of acts of two different descriptions; first, those to which the law annexes penalties; secondly, those to which disrepute and the dislike of others are annexed.

With respect to those acts to which the law annexes penalties, there is no room for uncertainty or dispute. Unless the law is a bad law, which ought to be repealed (this, we confess, constitutes an exception, and one, which, in very imperfect codes, extends a great way), the law ought not to be disappointed of its execution. The man who gives information against a murderer, or a thief, by the press, or without the press, renders a public service, and deserves not punishment but reward.

It appears, therefore, that the question, whether a man ought to be protected from the imputation of actions which he has really committed, refers solely to those acts which, without being punishable by the law, are attended with disrepute; acts, in other words, which the members of the society disapprove and dislike.

The prospect of the immediate and public exposure of all acts of this description, would be a most effectual expedient to prevent their being committed. Men would obtain the habit of abstaining from them, and would feel it as little painful to abstain, as at present it is to any well educated person to keep from theft, or those acts which constitute the ill manners of the vulgar. The fable of Momus has always been understood to carry an important moral. He found grievous fault that a window had not been placed in the breast of every man, by which, not his actions alone, but his thoughts, would have been known. The magnanimity of that Roman has been highly applauded, who not only placed his residence in such a situation that his fellow citizens might see as much as possible of his actions, but declared a wish that he could render open to the eyes of all his breast as well as his house.

If the hatred and contempt of the people, therefore, were always rightly directed, and rightly proportioned; if they never operated against any actions but those which were hurtful, either to the individual himself, or to others, and never, but in the degree in which they were hurtful, the case would be clear; the advantage which would be derived from the true exposure of any man's actions of any sort, would exceed beyond calculation the attendant evil. The great difficulty of insuring the practice of morality, in those numerous and highly important cases, to which the legal sanction, or the *security of pains and penalties* does not extend, consists in the want of a motive always present, and powerful enough to counteract the temporary motive which urges to the momentary offence. That motive almost every man would derive from his knowledge that the eyes were upon him of all those, the good opinion of whom it was his interest to preserve; and that no immoral act of his would escape their observation, and a proportionate share of their hatred and contempt. It is in this view that the aid of religion has been sometimes regarded as of importance to morality; suggesting the idea of a high and constant observer. All motives, however, are feeble, in proportion as the pains and pleasures upon which they depend are distant, and vague, or uncertain. Divines agree with all other men in complaining of the trifling effect of religious motives upon the lives of the greater number of men. From the nature of the prospect on which these motives depend, they were necessarily as feeble as they have so often been described. Such is not the case with the motives arising from the sentiments which we know we shall inspire in the breasts of our fellow creatures. It is a matter of daily and incontrovertible experience, that these are among the most powerful which operate upon the human mind. The soldier rushes upon death, and endures all the hardships and toils of his cruel profession, that he may enjoy the admiration, and escape the contempt, of his fellow men. On what else is founded the greater part of all the pursuits of mankind? How few, even of those who toil at the meanest occupations, but exert themselves to have something for show, something to make an impression upon the eyes of those who surround them? The very subject of the present inquiry derives from this source the whole of its importance. The value of reputation is, indeed, but another name for the value which we attach to the favourable and unfavourable sentiments of our fellow men.

It is, however, true, that their unfavourable sentiments do not always fall where they ought, and this, we confess, is a consideration of the highest importance. It very often happens that men's antipathies are excited to actions from which no evil ensues, either to him who performs them, or to any body else. If any man derives a pleasure from such actions, it is to limit his sphere of innocent enjoyment, to debar him from them. And if the press exposes him to the antipathies, the hatred, and contempt of his fellow-creatures, on account of those actions, it produces

an evil, uncompensated by the smallest portion of good. If an Indian Brahman were known to have eaten, even when starving, a morsel of food which had been prepared by a Christian, the consequences to him would be dreadful. Where the Roman Catholic religion is in vigour, a man who should indulge himself in animal food on forbidden days would be regarded with horror. The use of wine, however moderate, would render a Mahomedan execrable to the whole of his tribe.

This misdirection of the favourable and unfavourable sentiments of mankind, in other words, this perversion and corruption of their moral sentiments, has, in by far the greater number of instances, been the work of priests, contriving the means of increasing their influence. In some very important instances, such, for example, as the prejudices of birth, at one time so powerful in Europe, as to make ineffable contempt the lot of the low, the highest veneration that of the man of elevated birth, the perversion of the moral sentiments, is evidently the work of the aristocratical class, securing to themselves a more easy dominion over the rest of their fellow creatures. It is, therefore, evident, that where antipathies, religious or aristocratical, should prevail, the press would be hurtfully employed in giving notoriety to the facts which would expose a man to the operation of either.

We have now ascertained the cases in which it would *not* be good that men should be protected from the declaration of truth by the press, and also the cases in which it *would* be good that they should be so protected.

What, upon this view of the subject, would be desirable, is sufficiently clear. It would be desirable that, in the one set of cases, the declaration should be allowed, in the other it should not be allowed. Are the two sets of cases, however, capable of being accurately distinguished?

If the comparison is made with any attention, it will not be difficult to determine that the evil to be incurred by the loss of truth in the set of cases in which the declaration of it would be useful, is much greater than that which would arise from permitting the declaration in the cases in which it would be hurtful.

In the first place, the set of cases in which the declaration would be useful are much more numerous, and much more important, than those in which, in any tolerably civilized state of society, it would be hurtful. Those in which it would be useful embrace the whole field of morality, all those acts, the performance of which, on account of their singular importance, has been elevated to the rank of virtues. Every body believes and proclaims, that the universal practice of the moral virtues would ensure the highest measure of human happiness; no one doubts that the misery which, to so deplorable a degree, overspreads the globe, while men injure men, and instead of helping and benefiting, supplant, defraud, mislead, pillage, and oppress, one another, would thus be nearly exterminated, and something better than the dreams of the golden age would be realized upon earth. Toward the attainment of this most desirable state of things, nothing in the world is capable of contributing so much as the full exercise of truth upon all immoral actions,—all actions, the practice of which is calculated to lessen the amount of human happiness. According to this view, the justice of which it is impossible to dispute, the evil incurred by forbidding the declaration of truth upon all immoral actions is incalculable. That which would be incurred by the antipathies of misguided minds against actions innocent in themselves, nobody, we should imagine, would so much as think of placing in comparison.

In our own country, for example, the classes of actions which, though they injure nobody, expose a man to the unfavourable sentiments of others, are not numerous. The number of persons who would be exposed to inconvenience on account of the declaration of truth, in regard to them, would be small in comparison with those who would benefit by its declaration, in the case of all really hurtful acts.

It is, indeed, important to be observed, that a comparative smallness of number is necessarily implied in the supposition of injury from any unfounded antipathy. Those who share in the antipathy, of course, abstain from the action. And unless the antipathy were so general as to include almost the whole of the society, it would lose its injurious effect. Besides, all the injury which can be done to the individuals against whom truth would in this manner operate injuriously, would be, to make them abstain from the acts which were thus condemned.

Another thing to be considered is, that the whole of the evil arising from the exercise of truth is dependent upon an accidental circumstance, capable of being removed upon a mental disease, requiring to be cured; of which, of course, the legislature ought to undertake the case, and toward the cure of which truth is likely to operate as the most effectual of all expedients. If any considerable inconvenience were experienced from exposure to unfounded antipathies by publications of truth, the groundlessness of these antipathies could not fail to be so often canvassed, and made to appear, that at last it would become familiar to the multitude, and the antipathies would expire.

It clearly, therefore, appears, that, if the cases in which the declaration of truth would expose to unfounded prejudices could not be clearly defined, and separated from the cases in which the declaration would be salutary, the rule of permitting truth ought to be universal. But though we perceive, that, to a considerable extent, there are cases, in respect to which it would be vain to hope for agreement in drawing the line of distinction between what is hurtful and what is not, we are persuaded that principles might be laid down in which all would agree, and which would serve to mark out certain cases for exception with sufficient exactness. If any such cases could be separated, either of actions which, though injurious to nobody, excited antipathies, or of facts, as those of birth, for which, though a man was in no respect worse, he might be regarded as worse, the exercise of truth, with regard to them, might, on the express ground of these being actions innoxious, or facts which ought to be

Liberty of the Press.

of no importance in the estimate of human worth, be forbidden, when injurious, under the penalty of at least making reparation for all the injury of which it had been the cause.

Offences of the Press with respect to Government.

We have now explained, we trust, with sufficient clearness for the present occasion, the principles upon which laws should be constructed for protecting the *rights of individuals* against violations committed by the press. The first part of this inquiry, therefore, we must consider as completed. In the second part we have to explain the principles upon which they should be constructed for protecting *the operations of government*.

This question involves a point which presents the appearance of considerable difficulty. In the first place, unless a door is left open to resistance of the government, in the largest sense of the word, the doctrine of passive obedience is adopted; and the consequence is, the universal prevalence of misgovernment, with the misery and degradation of the people. In the second place, unless the operations of government, instituted for the protection of rights, are secured from obstruction, the security of rights, and all the advantages dependent upon the existence of government, are at an end. Between these two securities, both necessary to obtain the benefits of good government, there appears to be such a contrariety, that the one can only be obtained by the sacrifice of the other.

As this difficulty, however, arises chiefly from the largeness of the terms, a close inspection of the cases which they involve, and which they have a tendency to confuse, will enable us to discover the course which it belongs to practical wisdom to pursue.

It is necessary, first of all, to ascertain what sort of obstructions are inconsistent and what are not inconsistent, with the operations of government, which are necessary for the protection of rights.

The application of physical force to resist the government in applying, to the execution of the laws, the physical power placed at its disposal by the law, is such an obstruction of the operations of government as would, if frequent, render it inadequate to the ends which it is provided to secure. This application of force, therefore, must be treated as an offence; and any thing proceeding from the press, tending directly to produce it, as a similar offence.

This proposition requires to be illustrated. The application of physical force which is here described, and treated as an evil, is clearly distinguishable from that resistance of government which is the last security of the many against the misconduct of the few. This is an application of physical force to obstruct the operations of government in detail; the proceedings, for example, of a court of justice, the proceedings of the legislative organ, or the proceedings of any of the administrative functionaries, in the execution of the duties with which they are charged. This is not that species of resistance which is necessary in the last resort to secure the people against the abuse of the powers of government. This last is not a resistance to the operations of government in detail. It is a resistance to all the powers of government at once, either to withdraw them from the hands in which they have hitherto been deposited, or greatly to modify the terms upon which they are held.

Liberty of the Press.

Even this last species of resistance it may be necessary to punish, at least in a certain degree, whenever it is not successful; that society may not be disturbed by frequent commotions, in the motives to which, the majority of the people do not partake. This, however, is a question which belongs to the penal code in general, and does not concern the inquiry into the offences capable of being committed by the press: because we think it may be satisfactorily shown, that no operation of the press, however directly exhorting to this species of resistance, ought to be treated as an offence. The reason is, that no such exhortation can have any immediate or formidable effect; can, indeed, have any effect at all, except through such mediums as ought to be at all times perfectly free. Suppose that a work is published, exhorting the people in general to take arms against the government, for the purpose of altering it against the consent of its rulers. The people cannot take arms against the government without the certainty of being immediately crushed, unless there has been already created a general consent. If this consent exists in such perfection as to want nothing to begin action but an exhortation, nothing can prevent the exhortation, and forbidding it is useless. If the consent does not exist in nearly the last degree of perfection, a mere exhortation, read in print, can have no effect which is worth regarding. In all circumstances, therefore, it is useless, and consequently absurd, to treat this species of exhortation as an offence. If, on the other hand, it were clearly recognized, that every man had a licence to exhort the people to the general resistance of the government, all such exhortations would become ridiculous, unless on those rare and extreme occasions in which no prohibitions and no penalties can or ought to prevent them. The doctrine of this paragraph, which will appear somewhat startling and paradoxical to minds accustomed only to a certain train of ideas, will receive illustration and we trust will be amply confirmed as we proceed.

Having mentioned this as a grand exception, we now return to the cases in which not only physical force applied to obstruct the operations of government, but the publishing of exhortations to that obstruction, ought to be treated as an offence. These relate solely, as above remarked, to the operations of government in detail. Obstructions, it is evident, may be offered to the operations in detail of a government which possesses and deserves the fullest confidence of the community at large, and the press may be employed in directly and efficiently exciting to these obstructions. A hand-bill, for example, may be distributed in a morning, which, operating upon an inflamed state of mind, in a narrow district, may excite a mob to disturb the proceedings of a court of justice, to obstruct the officers of law, police, or government, in the execution of their duties, or to disturb, on this or that occasion, the deliberations of the legislature itself.

These are clearly hurtful acts; they may be very

accurately defined; and penalties, of moderate severity, would be sufficient to deter from the performance of them. The obligation of the offending party to make satisfaction to the party injured, would often, in offences of this description, be excluded, because there would be no definite party to whom an injury would be occasioned. It would only be necessary to ascertain the sorts of motives by which such offences would be liable to be produced, and to apply skilfully, as in other cases, motives of an opposite tendency, sufficient to counteract them. This would not be more difficult in this than in other cases, and it is not, therefore, necessary to explain at any length the mode of performing it. One principle is to be carefully and most religiously observed, that of not imposing an atom of punishment for the purposes of *vengeance*. This is a principle, the justness and importance of which are so completely recognized, that we might have expected to be relieved ere now from the necessity of recommending attention to it. The fact, however, is, that so long as there are abuses in governments, so long will the men who have the means of profiting by those abuses, exert themselves to multiply the list of offences against government, and to apply to them punishments of the greatest severity. Punishments for contempt of court; punishments to vindicate the honour of the court, of the government, of the magistracy; punishments for the support of dignity; punishments severe in proportion as the dignity of the party offended is supposed to be high, and so on, are punishments almost always applied for purposes of vengeance, or the protection of the instruments of abuse. They are punishments, therefore, which will be rigidly excluded from a code which wisely and steadily pursues the general good.

What the *sort of acts* are, to which the exhortations of the press ought not to be applied, has been so far ascertained. The next point is, to determine with accuracy what *sort of exhortation* it is that ought to be forbidden. To all those who profit by the abuses of government, that is, more especially to all those who, in a defective government, wield any of its powers, it is of great importance to leave, as undefined as possible, the sort of exhortation that ought to be forbidden. The point of greatest importance to them is, to keep the people at large from complaining, or from knowing or thinking that they have any thing of which to complain. If this grand object is fully attained, they may then, without anxiety, and without trouble, riot in the pleasures of misrule. There is no limit to the degree in which the few may pursue their own advantage at the expence of the many. There can be nothing, therefore, in which they have a greater interest, than preventing the press from being employed in any such way, as will lead the people to think that they have any thing, on the part of their rulers, of which to complain. All artifices possible will be sure to be employed to effect that prevention. And if it is enacted, that exhortations to acts which obstruct the operations of government in detail should be punished, *without defining accurately what sort of exhortations*, they will easily find expedients which, to a great extent, will accomplish their purpose.

Under the sort of constructions which it will be their interest to apply, every thing which can be done by the press, to make the people know or believe that there is any thing in the system of their government, or the conduct of their rulers, of which they have to complain, may be treated as an exhortation to obstruct the operations of government. Of these constructions, our experience affords innumerable examples. Does not the imputing of defects to the government, or misconduct to those who wield the powers of government, tend to bring both "into hatred and contempt?" And if the people hate and contemn the institutions and rulers of their country, will they not oppose their operations? The imputing of these faults, therefore, is it not, in essence and effect, an exhortation to oppose the operations of government? And are we to be governed, in our legislature, by the mere forms in which a set of words may appear, and not by our knowledge of their nature and consequences?

This is not only exceedingly plausible, but almost all the propositions which it involves are perfectly true. It is thus, therefore, the more easy to establish such a mode of interpreting an indefinite law of the press, as will prevent, or where the people cannot yet bear a total prevention, will go far towards preventing whatever can lead the people to believe that any thing is amiss in the manner in which they are ruled.

There are two species of exhortations, one the explicit and direct, the other implied and constructive. In the one, a particular act is pointed out, and the party, or parties, addressed are called upon to perform it. In the other, certain grounds only are laid, from which the opinion of the addresser may be inferred, more or less certainly, that the act ought to be performed.

With respect to the first, there is no occasion for doubt. A direct and explicit exhortation to commit one of those acts described above, as obstructing the operations of government in detail, should be treated as an offence. The precise question is, whether any exhortation, which is only implied and constructive, should be considered an offence? In the answer to this question, almost every thing which relates to the use of the press in matters of government, will be found to be involved.

We have already divided the subject of resistance to government into two parts; first, that general resistance, the object of which is, some great change in the government at large; and, secondly, resistance to this or that of its operations in detail.

We have already adduced an argument, which appears to us to be conclusive, to show, that no exhortation, whether explicit or implied, direct or indirect, the object or tendency of which is to produce the first species of resistance, ought to be subject to legal restraint.

It is necessary here to enter a little more fully into the grounds of that opinion.

We think it will appear, with sufficient evidence, that in the way of indirect exhortation to resistance,

that is, in laying the grounds of dissatisfaction with the government, there is no medium between allowing every thing and allowing nothing; that the end, in short, which is sought to be gained, by allowing any thing to be published in censure of the government cannot be obtained, without leaving it perfectly free to publish every thing.

The end which is sought to be obtained by allowing any thing to be said in censure of the government, is to ensure the goodness of the government, the most important of all the objects, to the attainment of which, the wisdom of man can be applied. If the goodness of government could be ensured by any preferable means, it is evident that all censure of the government ought to be prohibited. All discontent with the government is only good, in so far as it is a means of removing *real cause* of discontent. If there is no cause, or if there is better means of removing the cause, the discontent is, of course, an evil, and that which produces it an evil.

So true it is, however, that the discontent of the people is the only means of removing the defects of vicious governments, that the freedom of the press, the main instrument of creating discontent, is, in all civilized countries, among all but the advocates of misgovernment, regarded as an indispensable security, and the greatest safeguard of the interests of mankind.

For what is meant by a vicious government? or wherein do the defects of government consist? Most assuredly they all consist in sacrificing the interests of the many to the interests of the few. The small number, in whose hands the powers of government are in part directly, in part indirectly placed, cannot fail, like other men, to have a greater regard for what is advantageous to themselves, than what is advantageous to other men. They pursue, therefore, their own advantage, in preference to that of the rest of the community. That is enough. Where there is nothing to check that propensity, all the evils of misgovernment, that is, in one word, the worst evils by which human nature is cursed, are the inevitable consequence. (See the article GOVERNMENT.)

There can be no adequate check without the freedom of the press. The evidence of this is irresistible. In all countries, the people either have a power legally and peaceably of removing their governors, or they have not that power. If they have not that power, they can only obtain very considerable ameliorations of their governments by resistance, by applying physical force to their rulers, or, at least, by threats so likely to be followed by performance, as may frighten their rulers into compliance. But resistance, to have this effect, must be general. To be general, it must spring from a general conformity of opinion, and a general knowledge of that conformity. How is this effect to be produced, but by some means, fully enjoyed by the people, of communicating their sentiments to one another? Unless where the people can all meet in general assembly, there is no other means known to the world of attaining this object to be compared with the freedom of the press.

It is, no doubt, true, that in countries where the liberty of the press is unknown, evil governments are frequently overthrown. This is almost always accomplished by the military force, revenging some grievance of their own, or falling in with some heat and animosity of the people. But does it ever enable them to make a new government, in which any greater security is provided for their interests than there was before? In such cases, the people get rid of one set of rulers, whom they hate, only to obtain another set, with equal powers of doing them injury.

There are, however, we believe, some people who say, that though the liberty of the press is a necessary instrument to attain good government, yet, if it is fairly attained, and if legal and peaceable means are in the hands of the people of removing their governors for misconduct;—if the people of England, for example, really chose the members of the House of Commons, and renewed their choice so frequently as to have the power of removal after a short experience of misconduct, the freedom of the press would be unnecessary.

So far is this from being true, that it is doubtful whether a power in the people of choosing their own rulers, without the liberty of the press, would be an advantage.

It is perfectly clear, that all chance of advantage to the people from having the choice of their rulers, depends upon their making a good choice. If they make a bad choice—if they elect people either incapable, or disinclined, to use well the power entrusted to them, they incur the same evils to which they are doomed when they are deprived of the due control over those by whom their affairs are administered.

We may then ask, if there are any possible means by which the people can make a good choice, but the *liberty of the press*? The very foundation of a good choice is knowledge. The fuller and more perfect the knowledge, the better the chance, where all sinister interest is absent, of a good choice. How can the people receive the most perfect knowledge relative to the characters of those who present themselves to their choice, but by information conveyed freely, and without reserve, from one to another?

There is another use of the freedom of the press, no less deserving the most profound attention, that of making known the conduct of the individuals who have been chosen. This latter service is of so much importance, that upon it the whole value of the former depends.

This is capable of being rigidly demonstrated. No benefit is obtained by making choice of a man who is well qualified to serve the people, and also well inclined to serve them, if you place him in a situation in which he will have motives sufficient to serve himself at their expence.

If any set of men are chosen to wield the powers of government, while the people have not the means of knowing in what manner they discharge their duties, they will have the means of serving themselves at the expence of the people; and all the miseries of evil government are the certain consequences.

Suppose the people to choose the members of the Legislative Assembly, with power of rechoosing, or dismissing, at short intervals: To what desirable end

Liberty of the Press. could these powers be exercised, without the liberty of the press? Suppose that any one of those whom they have chosen has misconducted himself, or promoted, as far as depended upon him, the ends of misgovernment, how are the people to know that the powers with which they had entrusted him had been treacherously employed?

If they do not know, they will rechoose him, and that as cordially as the man who has served them with the greatest fidelity. This they are under a deplorable necessity of doing, even to be just; for, as they know no difference between him and the best, it would be on their part iniquity to make any. The consequences would be fatal. If one man saw that he might promote misrule for his own advantage, so would another; so, of course, would they all. In these circumstances, we see laid the foundation on which, in every country, bad government is reared. On this foundation it is impossible that it should not be reared. When the causes are the same, who can expect that the effects will be different? It is unnecessary to dwell upon these fundamental truths, because they have already been developed in the article Government.

Without the knowledge, then, of what is done by their representatives, in the use of the powers entrusted to them, the people cannot profit by the power of choosing them, and the advantages of good government are unavailable. It will surely not cost many words to satisfy all classes of readers that, without the free and unrestrained use of the press, the requisite knowledge cannot be obtained.

That an accurate report of what is done by each of the representatives, a transcript of his speeches, and a statement of his propositions and votes, is necessary to be laid before the people, to enable them to judge of his conduct, nobody, we presume, will deny. This requires the use of the cheapest means of communication, and, we add, the free use of those means. Unless every man has the liberty of publishing the proceedings of the Legislative Assembly, the people can have no security that they are fairly published. If it is in the power of their rulers to permit one person, and forbid another, the people may be sure that a false report,—a report calculated to make them believe that they are well governed, when they are ill governed, will be often presented to them.

One thing more is necessary, and so necessary, that, if it is wanting, the other might as well be wanting also. The publication of the proceedings tells what is done. This, however, is useless, unless a correct judgment is passed upon what is done.

We have now brought the inquiry to this important point: In the article Government, we have seen that, unless the people hold in their own hands an effectual power of control on the acts of their government, the government will be inevitably vicious. We have now seen, that they cannot exercise this control to any beneficial purpose without the means of forming a correct judgment upon the conduct of their representatives. We have likewise seen, that one of the means necessary to enable them to judge correctly of the conduct of their representatives, is the liberty to every body of publishing reports of what they do. It remains to inquire, by what other acts the press can be made to contribute to the same desirable end. Liberty of the Press.

What is wanted is, that all the people, or as many of them as possible, should estimate correctly the consequences of the acts proposed or done by their representatives, and also that they should know what acts might have been proposed, if the best were not proposed, from which better consequences would have followed. This end would be accomplished most effectually, if those who are sufficiently enlightened would point out to those who are in danger of mistakes, the true conclusions; and showing the weight of evidence to be in their favour, obtain for them the universal assent.

How is this to be accomplished? In what manner are those wise men to be chosen? And who are to be the choosers? Surely it is evident the object cannot be attained. There are no distinct and indubitable marks by which wisdom, and less by which integrity, is to be known. And who is to be trusted with the privilege of pointing them out? They whose judgment requires to be directed are not well qualified to determine who shall direct them. And if the rulers are to choose, they will employ those only who will act in uniformity to their views, and enable them to benefit themselves by the pillage and oppression of the people.

As there is no possible organ of choice, no choice whatever ought to be made. If no choice is to be made, every man that pleases ought to be allowed. All this is indubitable. The consequences of denying any part of it are so obvious, that hardly any man, we suppose, will risk the imputations to which such a denial would justly expose him.

They who say that no choice ought to be made, say, in effect, that no limit whatsoever ought to be imposed upon the liberty of the press. The one of these propositions is involved in the other. To impose any restraint upon the liberty of the press undoubtedly is to make a choice. If the restraint is imposed by the government, it is the government that chooses the directors of the public mind. If any government chooses the directors of the public mind, the government is despotic.

Suppose that, by the restraint imposed upon the liberty of the press, all censure of the government is forbidden, here is undoubtedly a choice. The government, in this case, verbally says, the people who might attempt the task of directing the public mind are of two sorts; one that of those who would censure, another that of those who would not censure: I choose the latter.

Suppose that not every censure, but only such and such kinds of censure, are forbidden, here, again, is still a choice, while confessedly there is no party to whom the power of choosing for the rest can with safety be given.

If not every censure, but only some censures, are to be forbidden, what are those to which the prohibition should extend? The answer to this question will elucidate nearly all that yet remains in any degree obscure, of the doctrine of the liberty of the press.

It will not be said that any censure which is just

Liberty of the Press.

should be forbidden; because that would undoubtedly be to detract from the means of enabling the people to form correct judgments; and we have, we trust, rendered it indisputable that no source of benefit to society is at all to be compared with that of correct judgments on their government and its functionaries, formed among the people, and determining their actions.

But what censures are just and what are unjust; in other words, what are the conclusions which ought to be formed respecting the properties and the acts of the government, is exactly the point to be determined. If you say that no man is to pass an unjust censure upon the government, who is to judge? It is surely unnecessary to repeat the proof of the proposition, that there is nobody who can safely be permitted to judge. The path of practical wisdom is as clear as day. All censures must be permitted equally, just and unjust.

Where various conclusions are formed among a number of men, upon a subject on which it would be unsafe, and therefore improper, to give to any minor portion of them a power of determining for the rest, only one expedient remains. Fortunately, that is an expedient, the operation of which is powerful, and its effects beneficial in the highest degree. All the conclusions which have formed themselves in the minds of different individuals, should be openly adduced; and the power of comparison and choice should be granted to all. Where there is no motive to attach a man to error, it is natural to him to embrace the truth; especially if pains are taken to adapt the explanation to his capacity. Every man, possessed of reason, is accustomed to weigh evidence, and to be guided and determined by its preponderance. When various conclusions are with their evidence presented with equal care and with equal skill, there is a moral certainty, though some few may be misguided, that the greater number will judge aright, and that the greatest force of evidence, wherever it is, will produce the greatest impression.

As this is a proposition upon which every thing depends, it is happy that the evidence of it should be so very clear and striking. There is, indeed, hardly any law of human nature more generally recognized, wherever there is not a motive to deny its existence. "To the position of Tully, that if Virtue could be seen, she must be loved, may be added," says Dr Johnson, "that if Truth could be heard, she must be obeyed." (*Rambler*, No. 87.)—"Je vous plains, mes Peres," says Mons. Pascal to the Jesuits, "d'avoir recours à de tels remedes. Vous croyez avoir la force et l'impurité: mais je crois avoir la verité, et l'innocence. C'est une etrange et longue guerre que celle ou la violence essaie d'opprimer la verité. Tous les efforts de la violence ne peuvent affoiblir la verité, et ne servent qu'à la relever davantage: toutes les lumières de la verite ne peuvent rien pour arrêter la violence, et ne font que l'irriter encore plus. Quand la force combat la force, la plus puissante detruit la moindre: quand l'on expose les discours aux discours, ceux qui sont veritables et convainquants confondent et dissipent ceux qui n'ont que la vanité et le mensonge." (*Lett. Provinc.* 12.)—"Reason," says Burke, "clearly and manfully delivered, has in itself a mighty force; but reason, in the mouth of legal authority, is, I may fairly say, irresistible." (*Lett. on Regicide Peace.*)

It is of importance to show how many of the greatest men, of all ages and countries, have borne testimony to the prevalence of true over false conclusions, when both are fairly offered to the human mind. "Truth," says Mr Locke, "certainly would do well enough, if she were once left to shift for herself. She seldom has received, and I fear never will receive, much assistance from the power of great men, to whom she is but rarely known, and more rarely welcome. She is not taught by laws, nor has she any need of force to procure her entrance into the minds of men." (*Letter on Toleration.*) The following is the emphatical language of Montesquieu: "La raison a un empire naturel; elle a même un empire tyrannique: on lui resiste, mais cette resistance est son triomphe, encore un peu de temps, et l'on sera forcé de revenir à elle." (*Esp. de Loix*, l. 28, ch. 38.)—"It is noted out of Cicero, by Machiavel, that the people, though they are not so prone to find out truth of themselves, as to follow custom, or run into error; yet if they be shown truth, they not only acknowledge and embrace it very suddenly, but are the most constant and faithful guardians and conservators of it." (*Harrington.*)—"The labour of a confutation," says Chillingworth, "I have not in any place found such labour or difficulty, but that it was undertakeable by a man of very mean abilities; and the reason is, because it is *Truth* I plead for; which is so strong an argument for itself, that it needs only light to discover it." (*Religion of Protestants.*)—"About things on which the public thinks long," says Dr Johnson, "it commonly attains to think right." (*Life of Addison.*)—"The adversary," says Dr Campbell, "is both subtile and powerful. With such an adversary, I should on very unequal terms enter the lists, had I not the advantage of being on the side of truth. And an eminent advantage this doubtless is. It requires but moderate abilities to speak in defence of a good cause. A good cause demands but a distinct exposition, and a fair hearing; and we may say, with great propriety, it will speak for itself." (Campbell on *Miracles.* Introd.)

We have then arrived at the following important conclusions,—that there is no safety to the people in allowing any body to choose opinions for them; that there are no marks by which it can be decided beforehand, what opinions are true and what are false; that there must, therefore, be equal freedom of declaring all opinions, both true and false; and that, when all opinions, true and false, are equally declared, the assent of the greater number, when their interests are not opposed to them, may always be expected to be given to the true. These principles, the foundation of which appears to be impregnable, suffice for the speedy determination of every practical question.

All censure thrown upon the government, all censure thrown either upon the institutions of the government, or upon the conduct of any of the func-

tionaries of government, supreme or subordinate, has a tendency to produce resistance to the government. Of the censures thrown upon government, some may have a tendency to produce resistance to the operations of government in detail; others to produce that general resistance which has in view some great alteration in the government.

Of the first sort would be any such accusation of the conduct and disposition of a judge, as might excite the people, whose sympathies were roused in favour of the individual against whom his sentence was to operate, to rescue him from the officers of justice. We have already shown that such a rescue ought to be punished, and any direct exhortation to it ought to be punished. It will now be evident, we trust, that no censure on the judge, though capable of being treated as an indirect exhortation, ought to be punished.

The reason is conclusive. The people ought to know, if possible, the real qualities of the actions of those who are entrusted with any share in the management of their affairs. This they have no chance of knowing, without the unlimited power of censure upon those actions, both in gross and detail. To see the full force of these propositions, it is only necessary to apply the principles which have been already established.

If the people have not the means of knowing the actions of all public functionaries, they have no security for the good conduct even of their representatives. Suppose it is the duty of their representatives to watch the conduct of the judges, and secure the perfection of judicature, the people cannot know whether their representatives perform their duty, unless they know what the conduct of the judges is. Ignorance of this would of itself suffice to vitiate the government. A door would be left open, through which the rulers might benefit themselves at the expence of the people. All the profit to be made by an abuse of the power of justice, would thus become the profit of the representatives, by whom it would be allowed, and encouraged as far as the knowledge, which they could not withhold from the people, would permit.

That the people ought, therefore, to know the conduct of their judges, and when we say judges we mean every other functionary, and the more perfectly the better, may be laid down as indubitable. They are deprived of all trust-worthy means of knowing if any limit whatsoever is placed to the power of censure.

All censure consists in the delivery of an unfavourable opinion, with or without the grounds of it. This is the essence of censure. But if the conduct of the judge deserves that an unfavourable opinion should be entertained of it, the more perfectly that is known to the people the better.

The conduct of the judge, on this occasion, says a defender, does not deserve an unfavourable opinion: A public expression of such an opinion ought, therefore, to be prohibited. But the conduct of some judge, on some occasion, deserves an unfavourable opinion. When it is deserved, there is no security for good government, unless it is allowed to be made known. How can you allow an unfavourable opinion to be delivered in the one case, and not delivered in the other? To have the benefit of it in the one case, you must submit to the evil of it in the other.

As the real point of importance is, to establish correct opinions in the minds of the people, it is as mischievous to inculcate a favourable opinion, when an unfavourable is deserved, as an unfavourable when a favourable is deserved; and, in the eye of reason, it is incontrovertible, that, if the one deserves to be prevented by punishment, so does the other. But, if an unfavourable opinion is pronounced of any public functionary; of a judge, for example, would you have it left uncontradicted? Would you not grant the liberty of calling in question the truth of the allegations, and of supporting a different opinion? In that case, it is abundantly evident, that the character of no public functionary would be safe, and that any man, however deserving, might be made to appear the proper object of the most unfavourable sentiments.

It is perfectly certain, that it is not in the power of law to mark out, by antecedent definition, any sort of men, of whom it can say, all opinions favourable to such men shall be punished. It can never be affirmed of any men beforehand that they will certainly perform such and such injurious actions. If they do perform them, all declarations conformable with the matter of fact are good. But the question is, whether they have performed them? One man affirms that they have. Is that to be taken for granted? And is no man to be allowed to affirm the contrary, and to sift the grounds upon which the allegations of the other man are supported? It is by weighing well the evidence on both sides, that a well-founded opinion is capable of being formed. This is perfectly certain. It is equally certain, that the best security for having the evidence on both sides fully adduced, and the strength and weakness of it perfectly disclosed, is by permitting all those who are attached to different opinions to do what they can for the support of their own.

If it is evident that it ought not to be permitted to speak evil of public functionaries without limit, while any limit is put to the power of speaking well of them; it is equally evident that, for the purpose of forming a correct opinion of their conduct, it ought not to be permitted to speak well of them, and oppose any limit whatsoever to the power of speaking ill of them. It ought not to be permitted to speak evil of them without an equal liberty of speaking well; because, in that case, the evidence against them might be made to appear much stronger than it was. It ought not to be permitted to speak well of them without an equal liberty of speaking ill; because, in that case, the evidence in favour of them might be made to appear much greater than it really was. In either case, the people would be misguided, and defrauded of that moral knowledge of the conduct of their rulers, the paramount importance of which has so fully appeared.

It may be said (as by the short-sighted, if we did not anticipate them, it would be said), that if, by limiting the power of censure, the people are made to judge more favourably of their rulers than they deserve, the evil is small; but if they are permitted to

form a very unfavourable opinion, the consequences are alarming.

We believe it may be rigidly demonstrated, that no evils are greater than those which result from a more favourable opinion of their rulers, on the part of the people, than their rulers deserve; because just as far as that undue favour extends, bad government is secured. By an opinion of their rulers more favourable than they deserve, is implied an ignorance on the part of the people of certain acts of their rulers by which the people suffer. All acts by which the rulers have any motive to make the people suffer, are acts by which the rulers profit. When the ignorance of the people extends to material points, all the evils of bad government are secured. These are the greatest of all possible evils. To this it will not be said that the ignorance of the people ought to extend. On all material points, it is admitted, then, that the freedom of censure ought to be complete. But if it is to be allowed on great points, on those where it is calculated to exact the greatest disapprobation, what can be thought of their consistency who would restrain it on those where it is only calculated to excite a small? If it is proper to protect the people from great injuries at the hands of their rulers, by exciting a strong, it is good to protect them against small injuries by exciting a weak disapprobation.

To public functionaries may be imputed either acts which they have not performed, or a want of certain qualifications, moral or intellectual, which they do possess.

With respect to acts, and even dispositions, which do not, either directly or indirectly, concern their public function, the same protection may be safely extended to them as to private men.

Acts in their public capacity which they have not performed, may be imputed to them either by mere forgery, and without any appearance of ground, or they may be imputed with some appearance of ground. From permitting the former, no good can be derived. They ought, therefore, to be prevented, in the same way as false imputations, injurious to individuals in their private capacity. That there should be no restraint in imputing actions to any public functionary which he may appear to have done, flows immediately from the principles already established, and requires not that any thing should here be added to its proof. Any appearance sufficient to lay the foundation of the slightest suspicion, renders it useful to call the attention of the public to the suspected part, which can only be done by making the suspicion known. A man may, indeed, publish, as a matter of fact, what is supported by appearances which would only justify the slightest suspicion. In that case, he is sure of incurring the disgrace of temerity, if not of malignity; and this is all the penalty which needs or can safely be inflicted upon him.

In imputing inaptitude to a public functionary, on the score either of intellectual or moral qualities, scarcely any limitation would be safe. Every man ought to have liberty to declare upon this subject any opinion which he pleases, and support it by any evidence which he may think adapted to the end. If, in supporting his opinion of the inaptitude of any public functionary, he imputes to him actions which there is not even an appearance of his having performed, that limited prohibition, the propriety of which we have just recognised, will strictly apply. With this exception, freedom should be unimpaired.

We have now, therefore, explained, we hope sufficiently, in what manner the principles which we have established require that the use of the press should be regulated in speaking of the action of public functionaries, and their fitness for the duties which they are appointed to discharge; whether those functionaries are the immediate representatives of the people, or others whom it is the business of their representatives to control.

We have next to inquire in what manner those principles require that the use of the press should be regulated in speaking of the *institutions* of government. The illustrations already adduced will supersede the use of many words upon this part of the subject.

Institutions of government are good in proportion as they save the people from evil, whether it be evil created by the government, or not prevented by the government. Institutions of government are bad in proportion as they are the cause of evil to the people, either by what they create, or fail in preventing.

According to this statement, which it is impossible to controvert, institutions of government may, in strict propriety of speech, be said to be the cause of all the evil which they do not save the people from, and which any other institutions would save them from.

It is therefore of the highest importance that the people should know what are the institutions which save them from the greatest quantity of evil, and how much their own institutions want of being conformable to those best institutions.

Institutions of government are bad, either because those in whose hands the powers of government are placed do not know that they are bad, and though willing, cannot improve them; or they are bad, because those who have in their hands the powers of government do not wish that they should be improved.

Where the rulers are willing, but do not know how to improve, every thing which leads to a knowledge of these defects is desirable to both rulers and people. That which most certainly leads to such knowledge is, that every man who thinks he understands any thing of the subject, should produce his opinions, with the evidence on which they are supported, and that every man who disapproves of these opinions should state his objections. All the knowledge which all the individuals in the society possess upon the subject is thus brought, as it were, to a common stock or treasury, while every thing which has the appearance of being knowledge, but is only a counterfeit of knowledge, is assayed and rejected. Every subject has the best chance of becoming thoroughly understood, when, by the delivery of all opinions, it is presented in all points of view; when all the evidence upon both sides of every question is brought forward, and all those who are most interested in showing the weakness of what is weak in it, and the

strength of what is strong, are, by the freedom of the press, permitted, and by the warmth of discussion excited, to devote to it the keenest application of their faculties. False opinions will then be delivered. True; but when are we most secure against the influence of false opinions? Most assuredly when the grounds of these opinions are the most thoroughly searched. When are the grounds of opinions most thoroughly searched? When discussion upon the subject is the most general and the most intense; where the greatest number of qualified persons engage in the discussion, and are excited by all the warmth of competition, and all the interest of important consequences, to study the subject with the deepest attention. To give a body of rulers, or any other body of men, a power of choosing for the rest opinions upon government without discussion, we have already seen, upon good evidence, is the way to secure the prevalence of the most destructive errors.

When institutions are bad, and the rulers would gladly change them if they knew they were bad, discussion, it will not be disputed, would be good for both parties, both rulers and ruled. There is, however, another case, and that by far the most common, where the rulers are attached to the bad institutions, and are disposed to do all in their power to prevent any alteration. This is the case with all institutions which leave it in the power of them who are entrusted with the powers of government, to make use of them for their own advantage, to the detriment of the people; in other words, which enable them to do injury to the people, or prevent the people from good. This is the case with by far the greater number of those institutions by which the people suffer. They are institutions contrived for benefiting the few at the cost of the many.

With respect, therefore, to the greater number of defective institutions, it is the interest of the rulers that true opinions should not prevail. But with respect to these institutions, it is of still greater importance to the people that discussion should be free. Such institutions as the rulers would improve, if they knew that they were defective, will be improved as the rulers themselves become sensible of their defects. Such defective institutions as the rulers would not wish to see improved, will never be improved, unless the knowledge of these defects is diffused among the people, and excites among them a disapprobation which the rulers do not think it prudent to disregard.

That the prevalence of true opinions among the people, relative to those defects in their political institutions, by which the rulers profit at their expence, is of the utmost importance to the people, is therefore a proposition which no improbity will dare openly to controvert. That freedom of discussion is the only security which the people can have for the prevalence of true opinions has already been proved. It is therefore proved that freedom of discussion, in its utmost perfection, they ought to enjoy.

What is included in the term *freedom of discussion*, is evident from what has already been said.

Freedom of discussion means the power of presenting all opinions, equally, relative to the subject of discussion; and of recommending them by any medium of persuasion which the author may think proper to employ. If any obstruction is given to the delivering of one sort of opinion, not given to the delivering of another; if any advantage is attached to the delivering of one sort of opinion, not attached to the delivery of another, so far equality of treatment is destroyed, and so far the freedom of discussion is infringed;—so far truth is not left to the support of her own evidence, and so far, if the advantages are attached to the side of error, truth is deprived of her chance of prevailing.

To attach advantage to the delivering of one set of opinions, disadvantages to the delivering of another, is to make a choice. But we have already seen, that it is not safe for the people to let any body choose opinions for them. If it be said, that the people themselves might be the authors of this preference, what is this but to say, that the people can choose better before discussion than after; before they have obtained information than after it? No, if the people choose before discussion, before information, they cannot choose for themselves. They must follow blindly the impulse of certain individuals, who, therefore, choose for them. This is, therefore, a pretence, for the purpose of disguising the truth, and cheating the people of that choice, upon which all their security for good government depends.

If these deductions are as clear and incontrovertible as to us they appear to be, the inquiry respecting the principles which ought to regulate the use of the press is drawn pretty nearly to its close. We have shown, that as far as regards the violation of the rights of individuals in respect to both persons and things, no definition on account of the press is required. We have shown in what manner the rights of individuals, in regard to reputation, should be defined by the civil code, and the violation of them prevented by the penal. We next proceeded to what may be considered as the main branch of the inquiry, namely, the use of the press in speaking of the institutions and functionaries of government. We have found, that in this respect the freedom of the press is of such importance, that there is no security for good government without it. We have also found, that the use of it, in respect to these subjects, admits but of two useful restrictions;—that of a direct exhortation to obstruct any of the operations of government in detail, and that of imputing to a functionary of government a criminal act, which there was no ground, nor even any appearance of ground, to impute to him. These restrictions, of course, it would be very easy to define in the criminal code, and to find appropriate motives to sanction. In all other respects, we have seen that the press ought to be free; that if there is any limit to the power of delivering unfavourable opinions, either of the functionaries or the institutions of government, and of recommending those opinions by any media, with the single exception of false facts, under the circumstances mentioned above, the benefits which may be derived from the freedom of the press are so greatly infringed, that hardly any security for good government can remain.

In the administration of English law, or rather of

what is called law, upon this subject, without being any thing better than the arbitrary will of the judges, it is said, that though discussion should be free, it should be "decent;" and that all "indecency" in discussion should be punished as a libel. It is not our object in this discourse to give an exposition of the manifold deformities of the English law of libel. If we have been successful in developing the true principles which ought to regulate the freedom of the press, every reader may, by an application of those principles, determine what he ought to think of the several particulars which may there attract his attention. We shall confine ourselves to a short notice of those *dicta*, or doctrines, which seem most likely to be pleaded in opposition to the principles which we have endeavoured to establish.

The question is, whether *indecent* discussion should be prohibited? To answer this question, we must, of course, inquire what is meant by indecent. In English libel law, where this term holds so distinguished a place,—is it not defined? English legislators have not hitherto been good at defining; and English lawyers have always vehemently condemned, and grossly abused it. The word "indecent," therefore, has always been a term under which it was not difficult, on each occasion, for the judge to include whatever he did not like. "Decent," and "what the judge likes," have, therefore, been pretty nearly synonymous.

Indecency of discussion cannot mean the delivery either of true or of false opinions, because discussion implies both. In all discussion there is supposed at least two parties, one who affirms and one who denies. One of them must be in the wrong.

The delivery, then, not of all true opinions, yet of some, may be said to be indecent. All opinions are either favourable or unfavourable. True opinions which are favourable to government and its functionaries will not be said to be indecent, nor will all opinions that are true and unfavourable be marked out for prohibition under that name. Opinions unfavourable may either be greatly unfavourable or slightly unfavourable. If any unfavourable opinions are exempted from the charge of indecency, it must be those which are slightly so. But observe, what would be the consequence of prohibiting, as indecent, those which are greatly unfavourable. A true opinion, greatly unfavourable to a functionary, or institution of government, is an opinion that the functionary, or institution, is greatly hurtful to the people. You would permit the slight evil to be spoken of, and hence removed; you would not permit the great evil to be spoken of.

If no *true* opinion can be regarded as indecent, meaning by indecent, requiring *punishment*, we must inquire if any *false* opinion on matters of government ought to be treated as such. If all false opinions are indecent, all discussion is indecent. All false opinions, therefore, are not indecent. The English libel law does not treat any favourable opinions how much soever false, as indecent. If all opinions that are false and unfavourable are said to be indecent, who is to judge if they are false? It has been already proved, that the people can confide the power of determining what opinions are true, what are false, to none but themselves. Nothing can resist this argument. Either the people do know, or they do not know, that an opinion is false. If they do not know, they can permit nobody to judge for them, and must leave discussion its free course. If they do know, all infliction of evil for the delivery of an opinion which then can do no harm, would be purely mischievous and utterly absurd.

If all opinions, true and false, must be allowed to be delivered, so must all the *media* of proof. We need not examine minutely the truth of this deduction, because it will probably be allowed. It will be said, however, that though all opinions may be delivered, and the grounds of them stated, it must be done in calm and gentle language. Vehement expressions, all words and phrases calculated to inflame, may justly be regarded as indecent, because they have a tendency rather to pervert than rectify the judgment.

To examine this proposition, it must be taken out of that state of vagueness in which so many things are left by the English law, and made, if possible, to speak a language, the meaning of which may be precisely ascertained.

We have just decided, as appeared, on very substantial grounds, that the statement of no opinion, favourable or unfavourable, true or false, with its media of proof, ought to be forbidden. No language, necessary for that purpose, can be indecent, meaning here, as before, nothing by that term, as nothing can be meant, but simply *punishable*, or proper for punishment.

But the only difference between delivering an opinion one way and another way is, that in the one case it is simply delivered, in the other it is delivered with indications of passion. The meaning of the phrase in question then must be, that an opinion must not be delivered with indications of passion. What! not even a favourable one? "Oh, yes! a favourable one. Merited *praise* ought to be delivered with warmth." Here, then, is inequality, and therefore mischief at once. An opinion, meaning here a true opinion, if it is favourable, you allow—if unfavourable, you do not allow—to be delivered in a certain way. Why? Because in that way, you say, it is calculated to make an undue impression. Opinions favourable, then, you wish to make an undue impression, and by that confess the wickedness of your intention. You desire that the people should think better of the institutions and functionaries of their government than they deserve; in other words, you wish the government to be bad.

If opinions, to what degree soever unfavourable, may be freely and fully delivered, there are two conclusive reasons why the terms in which they are delivered should not be liable to punishment. In the first place, the difference between one mode of delivery and another is of little consequence. In the second place, you cannot forbid the delivery in one set of terms, without giving a power of preventing it in almost all.

1. *The difference is of little consequence.* If I say barely that such a functionary of government, or such an institution of government, is the cause of great injury and suffering to the people, all that I

can do more by any language is, to give intimation, that the conduct of such functionary, or the existence of such institution, excites in me great contempt, or great anger, or great hatred, and ought to excite them in others. But if I put this in the way of a direct proposition, I may do so, because then it will be a naked statement with regard to a matter of fact, and cannot be forbidden, without overthrowing the whole of the doctrine which we have already established. If, then, I give indication of certain sentiments of mine, and of my opinion of what ought ot be the sentiments of others *explicitly*, I ought, you say, to be held innocent; if *implicitly*, guilty. Implicitly, or explicitly, that is the difference, and the whole of the difference. If I say, that such a judge, on such an occasion, took a bribe, and pronounced an unjust decision, which ruined a meritorious man and his family, this is a simple declaration of opinion, and ought not, according to the doctrine already established, to meet with the smallest obstruction. If I also state the matter of fact with regard to myself, that this action has excited in me great compassion for the injured family, and great anger and hatred against the author of their wrongs, this must be fully allowed. I must further be allowed to express freely my opinion, that this action ought to excite similar sentiments in other members of the community, and that the judge ought to receive an appropriate punishment. Much of all this, however, I may say in another manner. I may say it much more shortly by implication.—Here, I may cry, is an act for the indignation of mankind! Here is a villain, who, invested with the most sacred of trusts, has prostituted it to the vilest of purposes! Why is he not an object of public execration? Why are not the vials of wrath already poured forth upon his odious head?—All this means nothing, but that he has committed the act; that I hate him for it, and commiserate the sufferers; that I think he ought to be punished; and that other people should feel as I do. It cannot be pretended, that between these two modes of expression the difference, in point of real and ultimate effect, can be considerable. For a momentary warmth, the passionate language may have considerable power. The permanent opinion formed of the character of the man, as well as the punishment which, under a tolerable administration of law, he can sustain, must depend wholly upon the real state of the facts; any peculiarity in the language in which they may have been originally announced soon loses its effects. If that language has expressed no more indignation than what was really due, it has done nothing more than what the knowledge of the facts themselves would have done. If it has expressed more indignation than what was due, the knowledge of the facts operates immediately to extinguish it, and, what is more, to excite an unfavourable opinion of him who had thus displayed his intemperance. No evil then is produced; or none but what is very slight and momentary. If there should be a short-lived excess of unfavourable feeling, we have next to consider what is the proper remedy. Punishment should never be applied, when the end can be attained by more desirable means. To destroy any excess of unfavourable feeling, all that is necessary is, to show the precise state of the facts, and the real amount of the evil which they import. All excess of feeling arises from imputing to the facts a greater efficacy in the way of evil than belongs to them. Correct this opinion, and the remedy is complete.

2. *You cannot forbid the use of passionate language, without giving a power of obstructing the use of censorial language altogether.* The reason exists in the very nature of language. You cannot speak of moral acts in language which does not imply approbation and disapprobation. All such language may be termed passionate language. How can you point out a line when passionate language begins, dispassionate ends? The effect of words upon the mind depends upon the association which we have with them. But no two men have the same associations with the same words. A word which may excite trains of emotion in one breast, will excite none in another. A word may appear to one man a passionate word, which does not appear so to another. Suppose the legislature were to say, that all censure, conveyed in passionate language, shall be punished, hardly could the vices either of the functionaries or institutions of government be spoken of in any language which the judges might not condemn as passionate language, and which they would not have an interest, in league with other functionaries, to prohibit by their condemnation. The evil, therefore, which must of necessity be incurred by a power to punish language to which the name of *passionate* could be applied, would be immense. The evil which is incurred by leaving it exempt from punishment is too insignificant to allow that almost any thing should be risked for preventing it.

Religion, in some of its shapes, has, in most countries, been placed on the footing of an institution of the state. Ought the freedom of the press to be as complete, in regard to this, as we have seen that it ought to be, in regard to all other institutions of the state? If any one says that it ought not, it is incumbent upon him to show wherein the principles which are applicable to the other institutions fail in their application to this.

We have seen, that, in regard to all other institutions, it is unsafe for the people to permit any but themselves to choose opinions for them. Nothing can be more certain, than that it is unsafe for them to permit any but themselves to choose for them in religion. If they part with the power of choosing their own religious opinions, they part with every power. It is well known with what ease religious opinions can be made to embrace every thing upon which the unlimited power of rulers, and the utmost degradation of the people, depend. The doctrine of *passive obedience* and non-resistance was a *religious doctrine*. Permit any man, or any set of men, to say what shall and what shall not be religious opinions, you make them despotic immediately. This is so obvious, that it requires neither illustration nor proof.

But if the people here, too, must choose opinions for themselves, discussion must have its free course; and the same propositions which we have proved to be true in regard to other institutions, are true in regard to this.

(F. F.)

Limerick.

LIFE PRESERVERS. See PRESERVERS.

Situation and Extent.

LIMERICK, a county in Ireland, in the province of Munster, is bounded by the river Shannon, which separates it from Clare on the north; by Tipperary on the east; on the south by Cork; and on the south-west and west by Kerry. Its greatest extent, from east to west, is about 51 miles, and from north to south 32; and its area is about 1045 English square miles, or 688,800 English acres; which is divided into nine baronies, besides the liberties of the towns of Limerick and Killmalloch, and 126 parishes.

Surface, &c.

This is, in general, a low lying fertile district, surrounded by high grounds on the south-east, south, and west, from which the country has a gentle declivity towards the Shannon. The mountains on the south-east, called the Galtees, extend into Tipperary; and, on another range, very steep but less elevated, on the west, is the boundary with Kerry. On the banks of the Shannon there is a tract of low grounds, extending to more than 100,000 acres, chiefly alluvial, and of the richest quality. Besides the Shannon, this county is watered by several considerable streams. Of these the largest is the Maig, which has its source in the mountains on the south-east, and flowing through it from south to north, falls into the Shannon below Limerick. The Gale, and the Feale, which pass into Kerry, rise in the western mountains, and also the Blackwater, which flows eastward through the county of Cork on the south. The principal lake is Lough Gur, about five miles in circumference, in which there are three small islands. At the city of Limerick, rain falls for about two-thirds of the year; the barometer ranges between 28 and 30.5, and the thermometer between 28° and 74°. A great number of villas near this city, the summer residence of its wealthy merchants; several gentlemen's seats in different parts of the county, and some venerable ruins, both religious and military, give variety to a landscape which is not remarkable for its natural scenery.

Much of the county is divided among a few great proprietors, whose rentals are from L.2000 to L.40,000 a-year. The land seems to be of greater yearly value than in most parts of Britain at a distance from large towns; for, according to Mr Wakefield's information, the green acres would have let, in 1808, for three guineas the Irish acre, or almost 40s. the English. Considerable farms brought five guineas the Irish acre, and in some instances more. The rent of the mountain-land had increased in a still greater proportion than the grazing and corn farms. One grazier held land of the value of L.10,000 a-year, and in one season, slaughtered, in Cork, 800 head of cattle. Many of the best long-horned cattle of the united kingdom are fattened here, and also a considerable number of sheep. Two year old wethers sold then, without their fleeces, at from L.2, 10s. to L.3. Only a small proportion of the land is in tillage. The produce of this, and some of the adjacent counties, in proportion to the seed, is stated by the same author to be at a medium,—of wheat 10, bear 17, barley 12, oats 9, and potatoes 10. Hemp was formerly cultivated extensively on the rich low grounds, called the *Caucasses,* on the banks of the Shannon, but this tract is now occupied in grazing. Flax of an excellent quality, for sailcloth, is still grown in several parts. The common term of leases is 31 years and three lives.

Towns.

The towns and principal villages are, Limerick, Askeyton, Newcastle, Abbey-Feale, Adair, Killmalloch, Bruff, and Castle Connel. The last is a fine village, much resorted to for its mineral springs.

Limerick City.

Limerick is the only considerable town; and, next to Dublin and Cork, it is the most populous and commercial town in Ireland. Though situated on the Shannon, 60 miles from the sea, vessels of 300 tons come up close to the Custom-house: and it has a communication with Dublin by the Grand Canal. A large share of the provision and corn trade of Ireland is, accordingly, possessed by this city. In 1810, Limerick exported 50,998 barrels of wheat, 173,793 of oats, and 74,680 of barley, the value of the whole being little short of L.300,000. It is said to contain about 60,000 inhabitants. See LIMERICK, in the *Encyclopædia.*

Wages and Prices.

In 1811, the wages of common labour throughout the county were, of men, the year round, 1s. 2d. a-day, and of women, 9d.; in hay and corn harvest, 1s. 10½d. Potatoes were 3½d. *per* stone; beef and mutton, 6d. and 6½d. *per* pound; wheat, *per* barrel of 20 stones, 39s.; and oatmeal, 16s. 6d. the cwt.

Population.

Two members are returned to Parliament for the county, in which there are more than 3000 freeholders, and one for the city of Limerick. According to Mr Wakefield, two individuals have influence enough to return the member for the city and one of the county members. A colony of Palatines was established here more than a century ago, who still form a distinct race of industrious small farmers. The far greater part of the inhabitants are Catholics. These held much of the leasehold and personal property, but few large estates. Of the militia for the city of Limerick, consisting of 600 men, only seven of the privates were Protestants, at the time when Mr Wakefield wrote, and all the privates of the county militia were Catholics, excepting 50. Not a twelfth of the inhabitants of the city were Protestants. The population, in 1790, according to Dr Beaufort, was 170,000; it has been lately computed at 250,000. —See the general works referred to under the former Irish counties. (A.)

Lincolnshire.

Extent and Boundaries.

LINCOLNSHIRE, an English maritime county. It is bounded on the north by Yorkshire, on the east by the German Ocean and Norfolk, on the south by Cambridge, Northampton, and Rutland shires, and on the west by Nottinghamshire and Leicestershire. Its greatest length is 73 miles, and its greatest breadth 48. The area is 2814 square miles, or about 1,800,000 acres.

Divisions.

The county is divided into three districts or provinces. The largest of these, Lindsey, is more extensive than the other two, containing more than 1,000,000 acres, and stretching from the shores of the German Ocean to Nottinghamshire. It is rather an elevated tract of country, but the whole so level as scarcely to contain a single hill. The north-eastern part of this division is a very extensive district of heathy land, generally very poor, especially the northern part of it, and denominated the Wolds.

Lincolnshire.

Though some parts of it have recently been brought into cultivation, yet a great portion has scarcely any other live stock than the numerous rabbits, which multiply in extended warrens. A small part, however, of this division, contains a rich track of low land, formed by the rivers Trent, Dun, and Idle, where horned cattle are pastured, and some excellent flax is produced. The province of Lindsey is subdivided into fifteen hundreds and two sokes.

The province of Kesteven extends along the western side of the county, from its middle to its southern extremity; on which latter part is a portion of the fens. Notwithstanding there are many extensive heaths, especially near Lincoln and Ancaster, and though the soil and elevation is various, yet, on the whole, it may be properly described as a fertile country. Towards the west, a ridge of hills, which forms an abrupt boundary, extends from Grantham nearly to Lincoln; but none of the points attain a great elevation. This province is subdivided into nine hundreds and three sokes.

The third province, Holland, contains the greater part of that unhealthy division of Lincolnshire usually called the *Fens*. It is subdivided into three hundreds, sometimes denominated Sokes, sometimes Wapentakes. The character of this province is similar to the province of the same name in the Netherlands, after which it has been called. Nearly the whole of it appears, at a remote period, to have been covered by the sea, and only brought to its present state of productiveness by the active and persevering labour of the inhabitants. The embankments and the draining have been expensive, perpetual, and progressive, and the soil that has been redeemed has conferred a most abundant remuneration. Excellent pasture land has been formed out of the swamps and bogs, and some of it produces extraordinary crops of corn, especially oats. Even in those parts that have not been reclaimed, the reeds, which abound, are converted into good covering for houses and barns, and they are well stocked with

Wild Fowl.

aquatic wild fowl. The taking of them is a profitable employment to many persons, and the markets of London are principally supplied from thence with those delicacies. The decoys in this district are more numerous than in any other part of England. They are commonly formed around quiet pools, to which pipes made of bent willows, and covered with nets, gradually enlarging as they approach the water, are conducted. Into the large orifice of the pipes, the wild birds are enticed by tame ones trained for that business, and who conduct them into the funnel, when the appearance of a man or his dog behind, drives them to the most contracted part, where they are taken. The quantity of birds taken in some seasons is prodigious, amounting to some hundreds of thousands. They usually consist of teal, widgeon, and wild ducks, but occasionally wild geese, godwits, coots, ruffs, and reeves and whimbrels are caught. In these otherwise unproductive fens, the keeping of geese, principally for the sake of the feathers, is a considerable branch of rural industry, and supplies a large part of the demands of the kingdom, both for beds and for pens. The feathers are plucked from the birds at three, four, sometimes five different periods in the course of a year. This is thought to be a barbarous custom, but the charge is denied by the breeders, who assert, that, for their own profit, they pluck only those feathers which are so near falling off as to occasion little pain; those more firmly fixed, and which have some portion of blood at their end, being of very inferior value. The young ones are plucked as well as the old ones; experience having taught that, when plucked early, the future growth of the feathers becomes greater. During the breeding season, the birds are lodged in the same houses as their owners, in wicker pens, which are arranged in rows, frequently in the bed-chambers. A gooseherd in attendance on the flock leads them daily to water, and assists them, on their return, to get into their several cells. The attendants are acquainted with each individual goose in the flock, and can commonly distinguish them by the tones of their voices. Near Spalding, there is a considerable heronry, and a smaller one near Surfleet, where the herons, like rooks, build their nests on high trees.

The air in the fens is generally insalubrious, and the inhabitants suffer much from the nature of the water, which is generally of a brackish quality; and though they make reservoirs to preserve rain water, in dry summers, they experience very great distress. In warm weather, vast swarms of insects add to the annoyances of this district.

Popula

By the returns of 1811, the inhabitants of Lincolnshire were 237,891, viz. 117,022 males, and 120,869 females. In the preceding year the baptisms were 3963 males, 3857 females; the deaths 2736 males, and 2784 females. The houses were 47,467, which were inhabited by 50,904 families: of these 29,881 were chiefly employed in agriculture, 13,184 in trade, and 7839 in neither.

Towns

The towns containing more than 2000 inhabitants are the following:

	Houses.	Inhabitant
Lincoln (city),	1839	8861
Boston,	1837	8180
Gainsborough,	1227	5172
Lowth,	1035	4728
Stamford,	820	4582
Spalding,	944	4330
Grantham,	683	3646
Holbeach,	617	2962
Great Grimsby,	668	2747
Horncastle,	571	2622
Barton,	486	2204

The towns whose population is betwixt 1000 and 2000 are Sleaford, Crowland, Bourn, Swineshead, Donnington, Epworth, Crowle, Brigg, Alford, Wainfleet, Kirton-in-Lindsey, and Caistor.

Lincolnshire returns twelve members to the House of Commons, viz. two for the county, two for the city of Lincoln, and two for each of the boroughs of Boston, Grantham, Great Grimsby, and Stamford. The titles derived from places in this county are, of *Barons*, Brownlow, Bolingbroke, Boston, Holland, Grantham, Harrowby, Irnham (Irish); of *Earls*, Lincoln, Lindsey, Stamford, Yarborough, and Digby.

Lincolnshire.

The capital of this county is the see of a Bishop, whose jurisdiction is the largest of any in England, extending over the counties of Lincoln, Leicester, Huntingdon, Bedford, and Buckingham; over one half of Hertfordshire, and several portions of Oxfordshire, Berkshire, Rutlandshire, Northamptonshire, and Warwickshire; and including 1517 parishes under the superintendence of six archdeacons.

Rivers, Canals, and Dikes

The fens of Lincolnshire have through them wide ditches, which serve to drain the water from the land, and which, when united and extended, become navigable, and highly beneficial as means of conveying the productions to the various markets. The Foss Dike, the earliest canal made in Britain, was constructed in the year 1121, to form a connection between the city of Lincoln and the river Trent; and though, from the nature of the soil, it has been often obstructed, and the expence of keeping it in order has been great, it has continued to be used from that time to the present day. The river Trent, though rising in Staffordshire, may be considered as a Lincolnshire river, from the principal navigation upon it belonging to this county. It receives the Dun and the Ouse, and, before reaching the sea, unites with the Humber. It is navigable for large barges to Gainsborough. It has, on the influx of the tide, a most extraordinary *bore*, or, as it is provincially termed, *eager*, when the waters run up resembling a wall with a rapidity that has no equal in any of our English rivers, except the Wye at Chipstow. The Witham rises within the county, about ten miles from Stamford. The early part of its course is through a beautiful district till it reaches the fen country, when its course becomes sluggish; but being navigable to Boston, is highly beneficial both for draining and for commerce. The other rivers are the Ancholme, the Welland, the Glen, the Grant, and the Ouse. The Humber, indeed, is its boundary on part of the northern side, but is more commonly and properly considered as a Yorkshire than a Lincolnshire river, from Hull, its principal port, being in that county. Two small canals communicate with the river Witham, one from Horncastle, the other from Sleaford.

The great bay or estuary into which the different rivers and dikes that drain the fens are disembogued, is very shallow, and filled with drifting sands, that make the approach to the shore highly dangerous. The rivers are constantly loaded with mud, and, in times of flood, encounter the tide, equally charged with its floating silt, which causes a stagnation and deposit that is constantly shifting its position, as the strength of the rivers or of the tides happen to be the most powerful.

Face of the Country

The face of the country in the fens is generally uninteresting, exhibiting extensive plains, with nothing to break the continuity of the line of vision, and only rendered less monotonous by the vast numbers of cattle with which the green meadows are covered. On the wolds a more bleak and dreary prospect presents itself, but the western division of the country, near Stamford and Grantham, is variegated, woody, and undulating, and presents generally pleasing pictures.

Agriculture

The agriculture of the fens is of the simplest kind; for where nature has created such a productive soil, little remains to be done by the operations of man. In the more elevated parts of the county the cultivation is conducted with various, but, on the whole, good judgment; and the land produces ample crops of wheat, oats, barley, and beans, and, in some parts, hemp and flax. The attention, however, of the whole county is more turned to derive profit from cattle than from the use of the plough.

Oxen

The oxen of Lincolnshire are proverbial for their goodness. The original race were of a great size, with large heads and short horns, thick in the bone, deep in the belly, short on the neck, high on the rump, and bare on the shoulders; but these have been improved by such various and judicious crossings of breeds, that their symmetry and excellent qualities render them the best in the island. Many cattle bred in other countries are fattened here on the rich natural pastures, but a portion of oil-cake is very commonly given, to fit them earlier for the market of Smithfield, to which numerous droves are weekly dispatched. This fattening of cattle for the supply of London is so advantageous, that the dairy is almost everywhere considered as a secondary object.

Sheep.

The sheep of this county are almost peculiar to it. They are of a large size, have horns, and produce heavy fleeces of long wool, highly prized in the manufacture of stuffs and some kinds of baizes. The flesh is, however, rank in flavour, and, unless the animals are improved by crossing with other races, is not generally relished. As the foundation of an excellent breed, they were selected by the late judicious Mr Bakewell, who, from mixing them with other races, produced those excellent sheep known by the name of the "new Leicesters." The fleeces of the pure Lincolnshire sheep in general weigh from ten to twelve pounds, but extraordinary instances have been known in which they have attained more than twenty pounds.

Rabbits.

The live stock, in which this county exceeds every other, is rabbits, which the numerous warrens on the wolds produce in vast numbers. From their prodigious quantity the flesh is of small value, and the sale of the skins for the use of the furriers and hatters is the principal source of profit. The number of warrens has considerably diminished of late years, and the land they occupied appropriated to tillage; but they are still very extensive.

Trade and Manufactures

Lincolnshire is not a manufacturing county: before the extension of machinery, the spinning of their native wool gave occupation to the female part of the population, but that employment has been nearly discontinued of late years, and no other has yet been substituted in its place. In some parts the flax is spun for domestic use. The nature of its seashores operate to prevent foreign commerce, and there is little or no intercourse between Lincolnshire and the ports even of Holland and Germany, that are opposite to it. The county produces neither minerals nor coals.

Antiquities.

The antiquities of Lincolnshire are numerous. Almost all the churches are fine specimens of ancient architecture, a singularity which distinguishes them from those in every other county of England. The

Lincolnshire || Linlithgowshire.

remains of Crowland, founded in 716, the seat of a Mitred Abbot, and anciently a place of great fame, are still visited by every antiquary; and near them, is the triangular bridge over three streams, in good preservation. It is, however, so lofty and precipitous, that it is only useful to horse and foot travellers, as carriages usually pass under it. The other most prominent antiquities are Torksey Castle, at the junction of the Foss Dike with the Trent; Thornton Abbey, near the Humber; Bardney Abbey, on the banks of the Witham; Tattershall Castle, on the same river; and Somerton Castle, in the parish of Boothby.

Sir Isaac Newton, Lord Burleigh, Lord Bolingbroke, Stukeley the Antiquarian, and Wesley, the founder of Methodism, were, among many other eminent men, natives of this county.

The most remarkable seats of noblemen and gentlemen are, Blankney, Charles Chaplin, Esq.; Brocklesby Park, Lord Yarborough; Coleby Hall, Earl Lindsey; Gautby, Robert Vener, Esq.; Grinsthorpe Castle, Lord Gwydir; Hanby Hall, Sir Wm. Manners; Harmston, Sam. Thorold, Esq.; Hainton Park, G. Heneage, Esq.; Nocton Park, Earl of Buckinghamshire; Belton House, Lord Brownlow; Normanby Hall, Sir J. Sheffield; Reevesby Abbey, late Sir Joseph Banks; Subton, Sir Robert Heron; Summer Castle, Lady Wrey; Syston, Sir John Thorold; Thurgunby, Lord Middleton.

See Young's *General Agricultural View of Lincolnshire;* Brayley and Britton's *Beauties of England and Wales;* and Stone's *Agricultural Survey.*

(W. W.)

LINLITHGOWSHIRE, or WEST-LOTHIAN, a county in Scotland, having the Frith of Forth on the north, Edinburghshire, or Mid-Lothian, on the east and south-east, Lanarkshire on the south-west, and Stirlingshire on the west, is situated between 55° 49′ and 56° 1′ north latitude, and 3° 18′ and 3° 51′ west longitude from Greenwich. It is of a triangular form, about 19 miles long on its eastern boundary, and 13 on its western; but at a medium it is only about 7 miles broad and 16 long, according to the *Agricultural Survey*, and its area is therefore 112 square miles, or 71,680 English acres.

Extent.

Surface.

So large a portion of the surface of this county is either level, or gently undulating, that only a fifth part of it is stated to be unfit for cultivation. Yet a considerable space is occupied by hills. A ridge extends across it from north-west to south-east, of which Cairnpapple, the most elevated point, is about 1500 feet high. The highest ground is in the middle, and towards the west; on the south there is much moor and moss; but the hills for the most part yield good pasturage, and some of them are planted.

Climate.

The climate, though variable, is not severe. The prevailing winds are from the west, which blow for about two-thirds of the year. According to a register of the weather, kept at Duddingston on the coast of the Frith, about the middle of the northern boundary, the greatest number of rainy and snowy days, in any one year, for a period of thirty years, from 1778 to 1808, was 111 (in 1780), and the smallest number 22 (in 1803); but days on which slight showers fell are not included. The greatest heat in that period was in June 1785, when the thermometer stood at 87° in the shade, in a northern exposure. In June 1787, there was a week of frost, with ice one-sixteenth of an inch thick.

Soil.

Though there is a great variety of soil in this district, and considerable tracts of gravel and sand, yet clay is the most general. The better kinds of clay extend over a fourth of the area; but the inferior sorts, incumbent on a close bottom, are still more extensive.

Waters.

The only streams of any note are the Almond, which rises on the border of Lanarkshire, and flows north-east for about 24 miles between this county and Edinburghshire; and the Avon, which forms the western boundary for about 12 miles. Both these rivulets fall into the Frith of Forth. On the north side of the town of Linlithgow, there is a lake about a mile long, and half a mile broad, which contains pike, perch, and eels; and a smaller one on the south, stocked with the same kind of fish. In the parishes of Linlithgow, Ecclesmachan, and Abercorn, are several sulphureous springs, and a strong chalybeate is found in the parish of Torphichen; but none of them are much resorted to.

Minerals.

Silver and lead were at one time got in the hills of Bathgate, in the parish of Linlithgow, and in the neighbourhood a small vein of silver ore was found several years ago in a limestone quarry. Ironstone is wrought occasionally in the parishes of Borrowstounness and Carriden. Sandstone, in some places of an excellent quality, prevails along the coast of the Forth, and also in the interior; and there is an inexhaustible store of limestone. But the chief mineral production is coal, which abounds in almost every part of it, and is wrought in the parishes of Borrowstounness and Carriden on the Forth, in Uphall and Whitburn on the east and south, and in the parish of Bathgate in the middle. An excellent kind of coal has been wrought within these few years near Cultmuir, on the south-western border. The Union Canal, which passes through this county, will afford the means of transporting the coal of the interior to the city of Edinburgh. (See EDINBURGHSHIRE in this *Supplement*.)

Estates.

Linlithgowshire is for the most part divided into estates worth from L.200 to L.3000 a-year; but there are a few above, and several below these extremes. In the neighbourhood of the burghs of Linlithgow and Queensferry there are properties of only a few acres. Four of the greatest estates, rented at from L.4000 to L.10,000, belong to as many noblemen. In 1806, the number of freeholders, entitled to vote in the election of a member for the county, was 67. The valued rent, taken in 1649, is L.75,027, 12s. 2d. Scots; in 1806, the real rent was L.64,518, 18s. 7d. Sterling; and, in 1811, the real rent of the lands and mines was L.82,947, 2s., and of the houses L.5,798, 8s. Almost half the county is entailed.

Rental.

Seats.

The principal seats are Hopetoun House, Earl of Hopetoun, two miles west of Queensferry; Barnbougle Castle and Livingston House, Earl of Rosebery; Craigiehall, Mr Hope Vere; Duddingston, Mr Dundas; Hallyards, Mr Ramsay; Houston, Mr Sharp; Kinneil, Duke of Hamilton, near Borrowstounness; and Polkemmet, Mr Baillie.

Linlithgowshire. Farms.

The size of farms is from 50 Scots acres to 600, but the greater part are between 100 and 300 English acres. The rent of the better soils, which extend over half the county, varies from L.2 to more than L.5 the acre; that of the inferior clays is from 14s. to 20s., and of the high grounds from 6d. to 10d.; the average rent of the whole, in 1811, being rather more than 23s. the English acre. The common term of leases is 19 or 21 years; but, in some instances, they are for 24, 38, and even 57 years; grazing farms are let on short leases, from one to four years. The crops raised are the same as in the other counties in this quarter of Scotland, which have been already described; and the general system of husbandry is not materially different, except that the dairy is more an object here than in the counties to the east and south-east.

Towns, &c.

The towns are Linlithgow, Borrowstounness, and Queensferry; and the principal villages are Whitburn and Bathgate. Linlithgow, the county town, and a royal burgh, sixteen miles west from Edinburgh, contained, in 1811, 2557 inhabitants. It was formerly a place of considerable trade, but is now in a decaying state. The manufactures of the town and parish are paper, leather, stockings, malt, and spirituous liquors, calico printing and tambouring. The standard dry measures of Scotland were committed to the charge of this burgh, and still bear its name. These are the firlot of 2199 cubic inches for wheat, rye, beans, peas, meal, and salt; and another of 3208 cubic inches for malt, barley, and oats. The Palace, situated on an eminence overlooking the lake on the north side of the town, was founded by Edward I. of England. The Regent Murray was assassinated on the streets of this town, by Hamilton of Bothwellhaugh, on 22d January 1569. Borrowstounness is a port on the Frith of Forth, eighteen miles west from Edinburgh, containing about 2200 inhabitants, who are partly employed in shipbuilding, and in the manufacture of salt, earthenware, and soap. Queensferry, a royal burgh, is nine miles west from Edinburgh. The width of the Frith of Forth here is only two miles, with convenient landing-places on either side. (See QUEENSFERRY in the *Encyclopædia.*) In the middle of the Frith at this place is the small island of Inchgarvie, surmounted by a ruinous fort. The village of Bathgate is eighteen miles west, and Whitburn twenty-one south-west from Edinburgh. Borrowstounness is the only place which carries on some external commerce, but its trade has declined since the Forth and Clyde Canal was opened. The chief exports are coal, salt, and soap, and the imports timber, hemp, flax, &c. The herring fishery in the Frith is prosecuted with various success; the usual season is from November to February. There is also a salmon fishery on some parts of the coast, particularly between Queensferry and Blackness.

Representation, &c.

Linlithgowshire sends one member to Parliament; and, in the elections for the burghs, the town of Linlithgow unites with Selkirk, Peebles, and Lanark; and Queensferry with Stirling, Culross, Inverkeithing, and Dunfermline. It is divided into twelve entire parishes, and contains portions of other three, the rest of which belong to the county of Edinburgh. With the exception of the parish of Cramond, of which only a small part is situated in Linlithgowshire, all these parishes belong to the Presbytery of Linlithgow, in the Synod of Lothian and Tweeddale. The poor are relieved for the most part by the rents of land and interest of money, the donations of individuals, and from the ordinary funds of the kirk-sessions; but in some parishes poor-rates are raised by assessment. The annexed tables contain an abstract of the census of 1800 and 1811.

See *Beauties of Scotland,* Vol. III.; Trotter's *General View of the Agriculture of West Lothian,* 1811; *The General Report of Scotland,* and Playfair's *Description of Scotland,* Vol. I.; and for history and antiquities, Chalmers's *Caledonia,* Vol. II. (A.)

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
2,796	3,832	160	8,129	9,715	4,166	3,829	9,849	17,844

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
3,098	4,404	186	8,874	10,577	1,132	1,506	1,766	19,451

LITHOGRAPHY,

The art of taking impressions from drawings or writings made on *stone*.

The principles on which this art is founded are, 1*st*, The quality which a compact granular limestone has of imbibing grease or moisture; and, 2*dly*, The decided antipathy of grease and water for each other.

A drawing being made on the stone with an ink or crayon of a greasy composition, is washed over with water, which sinks into all the parts of the stone not defended by the drawing. A cylindrical roller, charged with printing-ink, is then passed all over the stone, and the drawing receives the ink, while the water defends the other parts of the stone from it on account of its greasy nature.

This process, therefore, depends entirely on chemical principles, and is thus distinct from letter-press or copper-plate printing, which are altogether mechanical. On this account it has in Germany been called *chemical printing*; and, as metallic plates can be prepared to be printed from in a similar manner, Lithography is considered only as a branch of chemical printing.

I. History of Lithography.

History of the Art.

The invention of Lithography was the result of accident. Its inventor, Alois Senefelder, the son of a performer at the Theatre-Royal of Munich, was placed for education in the University of Ingoldstadt, as a student of jurisprudence; but, after his father's death, he attempted a theatrical career. Not succeeding in this, he became an author, though his poverty prevented him from publishing his works. He now tried many plans with copper-plates and compositions, as substitutes for letter-press, in order to be his own printer. He found, in the course of his experiments, that a composition of soap, wax, and lamp-black, formed a good material for writing on his plates; that, when dry, it became firm and solid, and that it resisted aquafortis. Wanting facility in writing backwards on the plates, he got some pieces of Kilheim stone, as cheap materials, on which he could practise after polishing their surfaces. One day being desired by his mother to take an account of some linen about to be sent to be washed, and having no paper at hand, he wrote the account on a polished stone, with his composition ink, intending to copy it at his leisure. When he was afterwards about to efface this writing, it occurred to him that he might obtain impressions from it; and, having eaten away the stone with acid for about the hundredth of an inch, he found that he could charge the lines with printing-ink, and take successive impressions. This new mode of printing appeared to him very important, and he persevered through all difficulties in applying his discovery to practical purposes, and in improving it.

In the course of many experiments, he found that it was not necessary to have the letters raised above the surface of the stone, but that the chemical principles by which grease and water are kept from uniting, were alone sufficient for his purpose. This point obtained, Lithography may be said to have been fully discovered. All that was required was the improvement of the materials, and the mode of working with them, and the construction of a proper press for taking the impressions.

The perseverance with which he followed up his experiments, in order to overcome the difficulties which successively arose in his progress, is astonishing, and the more so, considering the total want of method in his proceedings. Often has he wasted months in surmounting a difficulty which a little knowledge, or a very little reasoning, would have enabled him to conquer immediately. His uniform plan seems to have been, to try the first thing that came to hand, and so on in succession, till chance rewarded his assiduity by presenting to him the material suited to his purpose.

The first essays to print for publication were some pieces of music, executed in 1796; afterwards he attempted drawings and writings. The difficulty he had in writing backwards led him to the process of *transfer*, and the use of dry soap, which was found to leave permanent traces, which would give impressions, naturally led to the mode of chalk drawings.

Having made considerable improvements, Mr Senefelder obtained, in 1799, a patent privilege for Bavaria, when he made known his process, and afterwards entered into partnership with Mr André, of Offenbach, who proposed to establish presses, and take out patents at London, Paris, and Vienna. For this purpose Senefelder came to London with a brother of André's, and the invention having been much spoken of, under the name of *Polyautography*, most of the principal English artists made trials of it. Unfortunately, however, the art of printing from the stones was not then fully understood, and the difference between the materials of Germany and those of England, used both for the purposes of drawing and printing, caused constant failures, and the artists in succession abandoned the practice of it. To this cause is to be attributed the unpopularity of Lithography till recently in England, as it was left entirely in the hands of *amateurs*, whose productions, generally speaking, did no credit to the art, and whose faults were in some degree supposed to be those of the art itself.

In August 1800, Senefelder, who had now separated from André, went to Vienna, where, after much difficulty, a patent was obtained, and extensive preparations were made, for applying his process to print cottons; but bad management, and some unfortunate circumstances, prevented his success, and he returned to Munich in 1806, leaving the establishment in other hands.

Mr Mitterer, Professor of Drawing at the Public School at Munich, now (1806) practised Lithography

Litho-graphy.

to multiply copies for the pupils, and is said to have invented the chalk composition in its present form, or at least to have improved it greatly.

From this period the practice of the art has extended and improved rapidly, and more particularly at Munich, where several establishments were formed, for the purpose of applying it to the fine arts, as well as for printing writings and official forms, for the different departments of the government.

In October 1809, Senefelder was appointed Inspector of the Royal Lithographic Establishment at Munich, for printing from stone a complete map and survey of Bavaria; since which period he has devoted his time to experiments, and to writing the history of his invention. Among other points of improvement to which his attention has been directed, is a substitute for the stones, which are inconvenient to use on account of their weight, and they are also liable to break in the press, when used without due caution, or when they contain flaws. For this purpose he has made a composition of drying oil, finely ground earth, and other substances, which is thinly spread over pieces of parchment; but it has not hitherto been found to answer. The surface cracks after repeated wetting and exposure to the power of the press, and the printing-ink is then taken in the cracks, and spoils the impressions. Thus a very small number only of good impressions can be obtained. A public exhibition of printing from this stone paper was made in London, on the 23d July 1821, by a partner of Mr Senefelder; but the result was not such as to induce much confidence in the ultimate success of the trials to form this desirable substitute of a light material for a heavy one.

In England Lithography can scarcely be said to have been entirely given up since its first introduction in 1800, although it was but little practised or thought of after 1805, till its revival at the latter end of 1817; since then it has been more generally attended to, and some of the establishments having now become well acquainted with the process of printing, specimens have been produced in England equal to those of any other country.

In France but little was done in lithography till 1815, when it was established at Paris by Lasteyrie, and being taken up by good artists, it soon attained great excellence. About the same time it extended to Russia and other parts of Europe.

II. Description of the Materials, and the Mode of Preparing them.

1. *Of the Stones, and the manner in which they are prepared to receive the Drawings.*

Stones

As calcareous stones will all imbibe grease and moisture, and effervesce with an acid (the use of which will appear when we speak of the process of printing), they are all capable of being used for Lithography. Those are best adapted to the purpose which are very compact, of a fine and equal grain, and free from veins, or imbedded fossils or crystals.

The quarries of Solenhofen, near Pappenheim in Bavaria, furnished the first plates, and none have as yet been found to equal them in quality. They are of a very uniform pale yellowish white colour. The fracture is perfectly conchoidal. The beds divide into thin portions of considerable size, with perfectly flat surfaces, and were on this account carried to Munich and other places for paving kitchens and halls, and thus came in the way of Senefelder, when he discovered the chemical process of printing.

The stones of this quarry vary in their quality, but the best are in great abundance. Generally speaking, the hardest are the best, provided they are quite uniform in texture. Such are necessary for fine chalk drawings, softer ones may do for ink, or for coarser drawings in chalk.

In France, stones have been found near Chateauroux (*Departement de l'Indre*), of a similar colour to those of Solenhofen, and even harder and of a finer grain, but they are so full of large spots of a softer nature, that it is scarcely possible to get one perfect of a greater size than twelve inches square.

In England a stone has been used for Lithography which is found at Corston near Bath. It is one of the white lias beds, but not so fine in grain or so close in texture as the German stone, and therefore far inferior. But it is good for transfers, and does tolerably well for ink drawings or writings. Another stone, found near Stony Stratford, is also used; but it is of a brownish grey tint, and too dark in colour to show the effect of the drawing with sufficient clearness.

To bear the pressure used in taking the impressions, a stone twelve inches square should be at least one inch and a quarter thick. The thickness must increase with the size of the stone, but two inches and a half are a thickness sufficient for stones of three feet by three feet and a half.

The stones, when sawn to a proper size and thickness, are ground level by rubbing two of them face to face with water and sand, and very carefully examined with a straight-edge, to ascertain that they are perfectly level in all directions. This applies only to the side which is afterwards to receive the drawing, as the natural division of the stone is sufficiently true for the back.

To prepare them for chalk drawings, two stones, which have been perfectly levelled, are well washed in order to free them from any of the coarser grains of sand which have been previously used upon them. They are now to be placed on a board over a trough, and a small quantity of water and very fine sand being strewed over the surfaces, they are to be rubbed face to face, adding occasionally a little fresh sand and water. The best sort of sand in England is that called silver sand, for preparing the stone, and the common brown sand for giving a fine grain. The sands must be passed through a sieve of the fineness required, which will vary with the nature of the drawing; and the greatest care must be taken to have the sieves perfect, and to prevent any coarser particles of sand from being mixed with the rest. A single grain would fill the stone with innumerable scratches, which would all appear in the drawing. The upper stone is in this operation moved in small circles, carefully and equally all over the under one, taking care not to move the one beyond the edge of the other, or the faces would become rounded. When the grain is equal, and sufficiently fine, the stones are carefully

washed, and wiped with a clean cloth. The stone, thus prepared, should have, when dry, a perfectly uniform appearance in the colour and grain, and resemble a sheet of vellum. It should be free from scratches, and have no shining parts. The upper stone is always the finer grained of the two.

Sometimes dry sand alone is used, but it is better to use it with water.

To prepare the stones for ink drawings or writings, the process just described is first followed; they are then well washed to get rid of the sand, and the same operation of rubbing two together is continued with powdered pumice-stone and water. When perfectly smooth, they are again washed, and afterwards separately polished with a large piece of fine pumice-stone with a circular motion. The polish now given to the stone should be such as to show the reflection of objects to the eye placed close to the stone, and looking along it towards the light.

When a writing or drawing has been fully used, and the stone is to be again prepared, sand is strewed over the surface, and it is sprinkled with water, and rubbed with another stone as before described, till the drawing has disappeared. It must then be washed with aquafortis diluted with twenty times its bulk of water. This is absolutely necessary to destroy the lines, which would otherwise partially re-appear in printing a second drawing from the same stone. After this the stone is again prepared for a new drawing with fine sand in the manner before described.

Ink drawings sink deeper into the stone than the chalk, and require the stone to be more ground away to efface them. The longer drawings remain on the stone, the deeper the ink or the chalk penetrates.

2. *Lithographic Ink and Chalk.*

For these materials the union of several qualities is required, and as no single substance possesses them all, it is necessary to combine several substances together.

Lithographic Ink.

Ink. A great many different receipts have been given, but as only two sorts are wanted, namely, one for writing on the stone, and one for transfer, it will be sufficient to give one of the most approved of each kind, and to point out the cause of any defect, with the means of remedying it. These defects are generally to be attributed to some fault in the preparation.

Composition of Lithographic Ink for Drawing on the Stone.

Tallow candle,	2 oz.
Virgin wax,	2 oz.
Shell lac,	2 oz.
Common soap,	2 oz.
Lamp-black, about one-twentieth of the whole.	

These materials are prepared in an iron saucepan with a cover. The wax and tallow are first put in and heated till they ignite; while they are burning the soap must be thrown in in small pieces, one at a time, taking care that the first is melted before a second is put in. When all the soap is melted, the ingredients are allowed to continue burning till they are reduced one-third in volume. The shell lac is now added, and as soon as it is melted, the flame must be extinguished. It is often necessary in the course of the operation to extinguish the flame, and take the saucepan from the fire, to prevent the contents from boiling over; but if, after the process above described, any parts are not completely melted, they must be dissolved over the fire without being again ignited.

Sometimes a larger proportion of wax is used, when only half of the soap is put in, and the burning goes on till the quantity is reduced one-half. The remainder of the soap is then added over a fire which keeps the mass melted without igniting it.

If the ink, in this state, is broken when cold, the pieces should adhere very slightly when pressed together between the fingers. If it works between the fingers like wax, it must be again burnt for a short time; if it is too brittle, and the broken parts will not adhere at all together by pressure, some more soap must be added in a second burning.

It should now dissolve, though with difficulty, by rubbing with warm water. The lamp-black, of the finest quality, must now be mixed with it, which is done while it is melted over a slow fire, adding small portions of the black at a time, and stirring them well together. The black increases its solubility for use, but too much is detrimental. When complete, it should, in its fracture, have the appearance of Indian ink, though it is softer. When the black is mixed with it, it must be cast on a marble slab and pressed with a heavy weight. The following rules for remedying defects in the ink are given by M. de Raucourt in his *Manuel de la Lithographie*, which is the most useful book yet published on the subject. It has been translated into English by Mr Hullmandel.

Defects of the Ink.	*Remedies.*
The ink is not soluble.	Add soap.
It is soft and attaches itself to the fingers.	Burn it more.
Some time after dissolving it in water it becomes thick and slimy, and requires a continual addition of water in order to be enabled to draw with it.	This is the defect of almost all inks; it proceeds from its not being sufficiently burnt. Burn it more.
The ink is not compact, and is full of bubbles.	It has been cast too hot on the marble slab; cast it again when it is less hot, and lay a heavier weight upon it.
The ink has no tenacity. It seems composed of scorias.	Both these defects may proceed either from its being too much burnt, or from its containing too much black; in either case, add equal portions of wax and soap, and melt on a slow fire.

Keeping in view the principles here pointed out, any one can, after a few trials, make good Lithographic ink.

Litho-graphy.

Ink for Transfers.

This is composed of the same materials as the preceding, but must be less burned. It will therefore be softer, and it must also be afterwards melted and mixed with a little more wax and thick varnish, such is described hereafter in speaking of the printing inks.

Lithographic Chalk.

Chalk. This should have the qualities of a good drawing crayon, it should be even in texture, and carry a good point. It is, however, difficult to avoid making it too soft and greasy on the one hand, and too brittle on the other. For the chalk, as for the ink, more or less of the soap, wax, and tallow, may be used as the extent of the burning may render necessary, and the remedies pointed out for defects of the ink will enable the operator to judge of what is wanting.

The following proportions are the best:

Common soap,	$1\frac{1}{2}$ oz.
Tallow,	2 oz.
Virgin wax,	$2\frac{1}{2}$ oz.
Shell lac,	1 oz.

The manipulation is similar to that for the ink. It is well, however, to throw in a little of the wax just before the flame is extinguished. Less black must be mixed with the chalk than with the ink, its only use being to colour the drawing, so that the artist may see the lines he traces.

When the whole is well mixed, it should be poured into a mould, and very strongly pressed to prevent any bubbles, which would make the texture irregular.

3. *Mode of Drawing.*

With these materials the artist proceeds to work on the prepared stone, taking care first to wipe the stone with a clean dry cloth. The ink being rubbed with warm water like Indian ink, is used on the *polished* stone; and it is to be observed, that a gradation of tints can be obtained only by varying the thickness of the lines, and the distance at which they are placed apart; as the line traced by the ink being sound and unbroken throughout, receives the printing ink all over. Hence it follows, that the artist cannot gain any advantage by diluting the ink for the lighter tints of the drawing, as the printing ink will take equally upon all the lines, and at once render all of them equally black. The object of the artist is to mix the ink to that consistency, which, while it works freely, shall yet be strong enough to stand perfect through the process of printing. A consistency, a little stronger than writing ink, is sufficient for this purpose.

The chalk will not hold upon the polished stone.

The *grained* stone, prepared for chalk, being carefully wiped to free it from dust, must be drawn upon with the crayon as common drawing chalk is used on paper. The subject may be traced on the stone with lead pencil or red chalk, but care should be taken to do this very lightly, so as not to fill up any of the grain of the stone. In drawing, the degree of pressure of the hand will vary the strength of the tint, and it is desirable to give the requisite strength at once; as the surface of the stone is a little altered by receiving the chalk, and hence it does not take any additional lines with the same equality. Practice is necessary to give a command of the material, as it does not work quite like the common crayon, there being great difficulty in keeping a good point. There is also much difficulty in obtaining the finer tints sound in the impression; and for the light tints, it is necessary to put the chalk in a reed, as the metal port-crayon is too heavy to draw them, even without any pressure from the hand; and therefore the artist cannot draw them with freedom, as his touch will be unsteady, by being obliged to support the pencil from the stone.

It is necessary to observe the grain with which the stone is prepared, which should vary with the fineness of the drawing. Several pieces of chalk should be prepared to use in succession, as the warmth of the hand softens it.

It is useful to cut the chalk to the form of a wedge rather than a point, as it is less likely to bend in that form.

Small portions of the point will break off during the drawing; these must be carefully removed with a small brush.

4. *Printing Press and Roller.*

Printing Press. The best sort of printing press for Lithography is represented in Plate XCV. the drawings being taken from one used by Mr Hullmandel.

Fig. 1. Is a side elevation of the press, with the scraper partly down.

2. A cross section through the middle.

3. A horizontal plan of the upper part.

4. Detail of the manner in which the scraper is held down during the impression.

5. End elevation of the press.

6. To explain the manner in which the centre of motion of the scraper is raised and lowered.

The press consists of a strong frame, having on the upper part a platten, or bed, *a*, to receive the stone, and which is moved along grooves in the upper part of the frame by means of a star-wheel, *b*, to the axle of which is fixed a cylinder, *c*. On this cylinder the straps, *dd*, are gathered, which work over the pulleys, *e*, fixed to the bed.

When the stone is placed on the bed, and ready for the impression, the frisket, or cover, *f*, of the bed, is brought down from the position marked by the dotted outline in fig. 1, and shut over the stone, as shown in the same figure. This cover consists of a strong piece of calf's skin, stretched by screws with nuts and hooks, which catch hold of an iron rod sewed along one end of the skin. The other end of it is fixed to the opposite end of the frame. (See fig. 3.) The cover is fixed to the bed by hinges, *g*, which can be screwed at different heights, according to the thickness of the stones. When the cover is opened, it rests against the frame, *h*, which can be adjusted to different heights. (See figs. 1 and 5.)

The cross piece, *i*, having the scraper, *k*, fixed in it, is now brought down, and the catches, *l*, lock into the upper part of the piece, *n*, sliding between the grooved upright, *m*. This is shown more in detail in fig. 4, the upper part, where the catches lock, is of iron, and has a joint and handle to pull it out

when the scraper is to be unlocked. A spring, *o*, keeps it generally in an upright position to be ready to hold the catches, *ll*.

When the scraper is locked down, the printer sets his foot on the treadle *p* of the lever, which presses the scraper with great power on the stone. The pressure is by a double lever, having a connecting rod, *q*, which can be adjusted so as to bring the upper arm *r* nearer to the treadle, when an increase of pressure is required, or a thinner stone is placed on the bed, which makes it necessary to bring the scraper lower down. The arm *r* passes through an iron frame on the sliding piece *n*, and thus brings it down when the treadle is depressed. The hook *s* holds down the treadle during the impression.

The star-wheel *b* is now turned round, and by this motion the bed is drawn under the scraper, and the impression is taken. The bed passes over a roller, *t*, which is placed with its centre directly under the scraper. See fig. 2.

As the stones are not always of the same thickness, the scraper must be brought to different heights. Fig. 6 shows an adjusting screw for the purpose of regulating the end farthest from the catches, there being a sliding piece between the grooved uprights, *u*, in which the centre is fixed, on which the cross piece *i* turns. The iron *v*, fig. 2, stops the cross piece and scraper from falling back.

When the bed has been drawn out, the printer releases the treadle, which is raised up by the balance weight, *w*, and the scraper being unlocked and thrown back, the bed is drawn to its first position by the weight, *x*.

As the surface of the stone is not always quite parallel to the bed, a simple contrivance has been adopted to allow a self adjustment of the scraper, which is allowed to turn on the centre, and pressed down by a spring acting on each end, but yielding if necessary at either. It is shown by the dotted lines in fig. 2. The screw *y* presses the scraper lower, or raises it if required.

The scrapers are made of beech wood.

The Roller.

Roller. The roller for inking the drawing is of the form represented, Plate XCV. fig. 7. The length may vary, but it ought to be full four inches in diameter. It is covered with flannel, rolled tightly three or four times round, and nailed at the ends. It is then covered with a stretched calf-skin, fitting quite tight. The seam must be made neatly with the boot-maker's closing stitch. The ends of the leather are gathered with a string, and tied round the projecting ends of the roller. Loose handles A, A, made of thick leather, are put on these ends when it is used. The leather must be put on the roller with the rough side outwards.

5. Printing Ink.

Printing Ink. The printing ink is composed, as other printing inks are, of oil, varnish, and very fine lamp-black, well mixed together. To prepare the varnish, a saucepan is about half filled with pure linseed oil, and heated over a fire, till it ignites from the flame of a piece of burning paper. It should then be allowed to burn till it is reduced to the degree required; and if, during the operation, there appears danger of its boiling over, it must be immediately taken off the fire, and the cover, which ought to fit quite close on the saucepan, must be put on to extinguish the flame. This is to prevent accidents; and the operator cannot be sufficiently cautioned against the danger attending the burning of the varnish, which ought never to be performed in a room with a boarded floor, or indeed in any part of a house. Wet sacks are the best things to put out the flame in case of accident.

Several inks must be prepared, differing in the degree of viscidity, or thickness of the varnish from which they are made, and the quantity of black mixed with them. The longer the oil is burned, the thicker the varnish becomes.

The thinnest varnish is burned till it has lost nearly one-fourth of its volume.

The next till it is reduced one-third.

The thickest till it is reduced one-half.

These directions are to be considered as very general ones; and the state of the varnish is best judged of during the burning, by taking out some with a spoon, and letting a drop fall on a cold earthenware plate, and trying its degree of vicidity with the finger. The thinnest sort should be like common honey, the other should draw out in strings, which will be longer as the varnish is thicker. The thickest will draw out in strings two or three feet long.

It is quite essential to have the oil pure, and the saucepan perfectly clean, and to keep the varnish in clean close jars in a cool place.

It is best not to make the varnish long before it is wanted; for if any decomposition takes place in it, the drawing will be spoiled by the printing ink.

The black is mixed with the varnish on a grinding stone with a muller, in small successive quantities; care being taken that the first portion of black is equally mixed with the varnish before a second is added. In the thickest inks this requires considerable labour.

By mixing the varnishes together, any degree of stiffness of the ink may be obtained; and by putting more or less black, its thickness is regulated.

The printer must always have by him several small pots, each containing a different printing ink, to be used as occasion requires. A small quantity, not more than the size of a hazel-nut, should be used at a time, for it is desirable to charge the roller with as small a quantity as possible. It must be worked well on the colour table with the roller in all directions, that it may be equally distributed all over the roller.

Ink drawings are generally printed with a stiffer ink than chalk drawings.

6. Preparation of the Stone for Printing.

The drawing being finished on the stone as before described, is sent to the Lithographic printer, on whose knowledge of his art the success of the impressions entirely depends. This first process is to etch the drawing, as it is called. This is done by placing the stone obliquely on one edge over a trough, and pouring over it very dilute nitric acid. It is poured on the upper part of the stone, and runs down all over the surface. The stone is then turned, and placed on the opposite edge, and the etching water, Etching

Lithography.

being collected from the trough, is again poured over it in the same manner. The degree of strength, which is little more than one *per cent.* of acid, should be such as to produce a very slight effervescence; after the etching water has lain on the stone for a second or two, its strength must vary according to the heat of the atmosphere, and the degree of fineness of the drawing. It is desirable to pass the etching water two or three times over the darkest parts of the drawing, as they require more etching than the lighter tints. Some stones also, and different chalks, require different degrees of strength of the acid, and experience alone can guide the Lithographer in his practice on this point. Chalk drawings require weaker acid than the ink.

The stone is now carefully washed, by pouring clean rain-water over it, and afterwards with gum-water; and when not too wet, the roller, charged with printing ink, is rolled over it in both directions—sideways, and from top to bottom, till the drawing takes the ink. It is then well covered over with a solution of gum-arabic in water, of about the consistency of oil. This is allowed to dry, and preserves the drawing from any alteration, as the lines cannot spread, in consequence of the pores of the stone being filled with the gum. After the etching, it is desirable to leave the stone for a day, and best not to leave it more than a week, before it is printed from. In some establishments a few proofs are taken immediately after the drawing is etched, but it is better not to do so.

The operation of the etching requires great nicety, and must be done quickly. If the drawing is etched too strongly, the fine tints disappear; if too weak, the printing ink mixes with the darker parts, and the drawing runs into blots. A soft stone requires weaker acid than a hard one, if they are equally pure in quality. The differences in the composition of the stones also require differences in the strength of the etching water, so that no strict rules can be given.

The effect of the etching is, *first*, to take away the alkali mixed with the drawing chalk or ink, which would make the drawing liable to be affected by the water; and, *secondly*, to make the stone refuse more decidedly to take any grease. The gum assists in this latter purpose, and is quite essential to the perfect preparation of the surface of the stone.

7. *Printing.*

Printing.

When the stone is to be printed from it is placed on the bed or platten of the press; at this time a proper sized scraper for the printing is very carefully adjusted to the surface of the stone. The gum on the stone is now sprinkled with rain-water, and being gradually dissolved, and a wet sponge passed lightly all over it, the printer works the ink which is on the colour table placed beside him, with the roller in all directions till it is equally spread and thinly all over the roller. He then (the stone being wet) passes the roller all over the stone in both directions, observing (as his experience enables him to do) that all parts of the drawing take the ink in due proportion. The roller should be applied with an equal motion and pressure, which must be regulated according to the mode in which the drawing takes the ink; if it does not take it readily, the pressure must be increased, and the roller moved more slowly.

The roller should turn freely as it passes over the stone; if it slips, the cause is either that the stone is too wet, or that too much of the gum remains upon the stone; in the first case, a drier sponge will correct the evil; in the second, the stone must be again washed with a little water; but this must be done with caution, as the gum should not be entirely washed off the stone.

At first the drawing receives the ink with some difficulty, and it is frequently necessary to wet the stone and roll it in several times, before it will take the ink readily. Care must now be taken not to wet the stone too much; the less dampness the better, provided it is sufficient to keep the stone from taking the ink in the parts where there is no drawing; at all events, no drops of water should be seen on the stone, as they spoil the printing ink, and also are imbibed by the roller, which therefore becomes unfit for use. After the drawing is thus rolled in, the sheet of paper is placed on the stone, and the impression taken in the manner described in the account of the press. When, after the impression, the paper is taken up, the stone appears dry, the moisture having been imbibed by the paper. It must be again wetted with a damp sponge, and rolled in with ink as before, taking care to work the roller well on the colour table each time before applying it to the stone.

Generally the first few impressions are imperfect, from the drawing not taking the ink fully, but this is gradually corrected.

During the printing some gum must always remain on the stone (though it will not be visible), otherwise the ink will take on the stone, and also spoil the drawing. If, by too much wetting or by rubbing too hard with the sponge, the gum is entirely removed, some fresh gum-water must be laid on. If the stone has, in the first instance, been laid by with too small a quantity of gum, and the ink stains the stone on being first applied to it, gum-water must be used to damp the stone instead of pure water. Sometimes, however, this may arise from the printing ink being too thin, as will appear below. If some spots on the stone take the printing ink, notwithstanding the above precautions, some strong acid must be applied to them with a brush, and after this is washed off, a little gum-water is dropped on the place. A steel point is here frequently necessary to take off the spots of ink.

The edges of the stone are very apt to soil, and generally require to be wiped with an old sponge or rag after the rolling in. They must also frequently have an application of acid and gum, and sometimes be rubbed with pumice-stone.

Chalk drawings are much the most difficult to print.

After this general description of the printing the following developement of the principles on which it is regulated, and notice of the difficulties which arise in its progress, will be found useful.

An ink which is too thin, and formed of a varnish not sufficiently burned, will soil the stone, notwithstanding the proper precautions are taken of wetting the stone, and preparing it properly with acid and gum.

Ink which is too stiff will tear up the lighter tints of the chalk from the stone, and thus destroy the drawing.

The consideration of these circumstances leads us at once to the principles of the printing. These

Lithography.

accidents arise at the extreme points of the scale at which the printing inks can be used, for it is evident, that the only inks which can be employed are those which are between these points, that is, thicker than that which soils the stone, and at the same time thinner than that which takes up the drawing. Lithographers are sometimes unable to print in very hot weather, the reason of this may be deduced from the above. Any increase of temperature will diminish the consistency of the printing ink; the stone will therefore soil with an ink which could be safely used at a lower temperature; hence a stiffer ink must be used. Now, if the temperature should increase so much that the stone will soil with any ink at all less thick than that which will take up the drawing, it is evident that the printing must cease till a cooler temperature can be obtained; for, as the drawing chalk is affected equally with the printing ink, the same ink will tear up the drawing at the different degrees of temperature.

This, though it sometimes occurs, is a rare case; but it shows that it is desirable to draw with a chalk or ink of less fatness in summer than in winter; and also, that if the printing-room is in winter artificially heated, pains should be taken to regulate the heat as equally as possible.

We will now enumerate some other difficulties which are not referable to the above general principle.

If the pressure of the scraper is too weak, the ink will not be given off to the paper in the impression, although the drawing has been properly charged with it. Defects will also appear from the scraper being notched, or not correctly adjusted, or from any unevenness in the leather or paper.

Inequalities in the roller will cause the drawing to receive the ink unequally, and if the roller or its leather is too hard, it will not ink the drawing clearly.

After printing a considerable number of impressions, it sometimes happens that the drawing takes the ink in dark spots in different parts. This arises from the printing ink becoming too strongly united with the chalk or ink of the drawing, and if the printing is continued the drawing will be spoiled. A little consideration will show us the reason of this accident. The printing ink readily unites with the drawing, and being of a thinner consistency, it will by repeated applications accumulate on the lines of the drawing, soften them, and make them spread. In this case it is necessary to stop the printing, and let the stone rest for a day or two, for the drawing to recover its proper degree of hardness. If the drawing should run smutty from any of the causes before enumerated, the following mixture will clean it.

Mixture to clean the Drawing while printing.

Take equal parts of water, spirits of turpentine, and oil of olives, and shake them well together in a glass phial, until the mixture froths, wet the stone, and throw this froth upon it, and rub it gently with a soft sponge. The printing ink will be dissolved, and the whole drawing also will disappear, though, on a close examination, it can be distinguished in faint white lines. On rolling in again with printing ink, the drawing will gradually reappear as clear as at first.

Bleached Paper unfit for Lithography.

Accidents sometimes occur in the printing, from the qualities of the paper. If the paper has been made from rags which have been bleached with oxymuriatic acid, the drawing will be incurably spoiled after thirty impressions. Chinese paper has sometimes a strong taste of alum; this is so fatal as sometimes to spoil the drawing after the first impression.

Preserving Ink.

When the stone is to be laid by after printing, in order that it may be used again at a future period, the drawing must be rolled in with a *preserving ink*, called by Senefelder, Aetzfarbe, as the printing inks would, when dry, become so hard, that the drawing would not take fresh printing ink freely. The following is the composition of the preserving ink.

Thick varnish of linseed oil,	2 parts.
Tallow, . . .	4 do.
Venetian turpentine, .	1 do.
Wax, . . .	1 do.

These must be melted together, then four parts of lamp-black very carefully and gradually mixed with it, and it must be preserved for use in a close tin box.

Tints.

Very good effects are produced in Lithographic prints, by printing from two or more stones with different coloured inks. This is managed by preparing a composition of

Wax, .	2 parts.
Soap, .	1 do.
A little vermillion.	

Melt them in a saucepan, and cast them into sticks. This must be rubbed up with a little water to the thickness of cream, and applied to the surface of a polished stone. An impression is taken in the common way from a drawing, and applied to a stone prepared in this manner, and passed through the press, taking care to mark, by means of this impression, two points in the margin corresponding on each of the stones. The artist having thus on the second stone an impression from the first drawing to guide him, scrapes away the parts which he wishes to remain white in the finished impression. The stone must now be etched with acid stronger than the common etching water, having one part of acid to twenty of water. The whole is then washed off with turpentine.

This plan has been very much followed at Munich. It is generally used to print a middle tint from the second stone. The black impression being given from the first stone, a flat transparent brownish tint is given from the second, and the white lights are where the paper is left untouched. The dots are necessary to regulate the placing of the paper on the corresponding parts of the two stones.

The coloured inks for the tints are differently made, according to the tint required, but the varnishes alone make very good light browns.

The paper for Lithographic Printing should not be so damp as for Copperplate Printing.

8. *Different manners of Lithography.*

Besides the manners already described of drawing with ink and chalk, Lithography is practised in various other ways.

Transfers.

Transfers.

The most useful of these is the transfer, before alluded to in speaking of the inks, as it saves the labour and inconvenience of writing backwards. This is performed by writing with the composition ink on a prepared paper, and then transferring the writing to a stone, by passing it through the press.

Lithography.

The paper is prepared as follows. A paste is made by dissolving, with heat, glue or starch in water till its consistency is such as to fix like a thin jelly when cold. It must then be mixed with gamboge and a little alum, in the following proportions:

Glue,	. . .	6 parts.
Gamboge,	. .	1 do.
Alum,	. . .	$0\frac{1}{2}$ do.

These must be mixed together over a fire, and applied while lukewarm in a thin coating on one side of a sheet of soft or unsized paper, which, when dry, must be rubbed over with a little powdered gum-sandarac. The writing is to be made with the fatter sort of ink on the prepared side.

When the transfer is to be made, a polished stone is warmed to about 130° Fahrenheit, and placed in the press. The paper is then carefully damped at the back with a sponge, and placed between some sheets of soft paper. It is next placed on the stone with the writing towards it and passed through the press as in printing an impression. This must be repeated four or five times without raising the leather cover of the bed of the press; beginning with a slight pressure at first, and increasing it every time. The press is now to be opened and the paper taken off, when the writing will appear to have come off the paper on the stone. If necessary, the paper may be a little damped, to raise it from the stone, but it should be done with care.

When the stone is quite cold, it is etched and prepared for printing in the usual manner.

This mode is of great use for circular letters and written forms, but does not do so well for works of art, as the lines lose their sharpness by spreading a little at the edges, from the warmth of the stone. To obviate this, Senefelder has proposed a fatter ink, which may be taken off on a cold stone.

Imitation of Wood Cuts.

This is a very easy mode, though not much practised. A polished stone is covered all over with lithographic ink, and the parts which are to be left white are scraped away with a steel point. Very fine lines are most easily obtained by putting them in with a hair pencil. The stone is etched as before described.

Etchings on Stone.

Lithographic Etchings.

A polished stone is prepared for this mode by washing it with diluted acid as weak as the water used for etching a drawing; and after that is washed off, and the stone is dry, it is to be covered with weak gum-water and a little lamp-black. This forms a coating to the stone, and the artist works on it with an etching needle, as in etching on copper. The lines he traces appear white, but look stronger than they will appear afterwards. The stone should be a little warmed, for the needle to work freely through the coating, and care must be taken not to breathe upon it. When the etching is finished, the surface is to be rubbed all over with linseed oil, which penetrates into the lines drawn by the needle. After this the coating is to be all washed off with water.

In this mode lines can be drawn as fine as on copperplate; it is, however, but little practised in England, though it is often employed in Germany.

General Observations on this Art.

The great distinction of Lithography from Engraving is, that it gives a fac-simile of an original drawing, which retains all the freedom and touch of the artist's own hand; while, on the contrary, an engraving must be a copy. This character in a lithographic print arises from the facility with which the drawing is produced; as the process is exactly that which the artist would follow in making a common drawing; and the farther advantage of a great saving of expence is derived from the same cause; for the drawing being made at once on the stone, the whole expence of the engraving is saved. This is particularly the case with drawings in chalk, or with outlines or slight works in ink; and thus the door is opened to the production of many works which could not otherwise be published on account of the expence of engraving.

The more finished drawings in ink, however, have not the same advantages, for the gradations in tint can be obtained only by the variations in the breadth and distance of the lines, which is the same principle as that on which the engraver works; and hence the labour is more nearly equal in the two methods.

It must be admitted, that there is much less difficulty, and consequently less education, required to draw the lines on the stone than to cut them on the copper, but no superiority is obtained in the impression; nor is there any other advantage attending the substitution of the stone for the copper than a saving of expence, which, from there being but few artists who have practised this mode of Lithography, is not considerable at the present time.

The number of impressions which can be taken from a chalk drawing will vary according to the fineness of the tints. A fine drawing will give 400 or 500; a strong one from 1000 to 1500.

Ink drawings and writings give considerably more than copperplates. The finest will give 6000 or 8000, and strong lines and writings many more. Upwards of 80,000 impressions have been taken at Munich from one writing of a Form for regimental returns.

If, however, we compare lithographic prints with fine line engravings, or more particularly with engravings in Mezzotinto, we shall observe, that the latter are more rich in their effect, and that the shadows have, in some places, more depth and brightness. This is in part obtained by cutting deeply into the copperplates, so as to lay on in the impression a mass of ink of a rich and deep black colour in the parts where it is wanted to increase the effect, and by this means the engraver extends the limits of his tints. Lithography will, perhaps, always remain inferior in this respect to line and mezzotinto engraving, as the principle on which it is founded is to print from the surface only. Some of the modes of engraving, such as soft ground etching and aquatint are inferior to Lithography.

Such may be said to be the present state of Lithography; but it must be recollected, that it is as yet but a new art, and doubtless susceptible of great improvement. It is very much in want of the attention and practice of better artists, who would not only produce better performances with the present materials, but would also be able to point out in

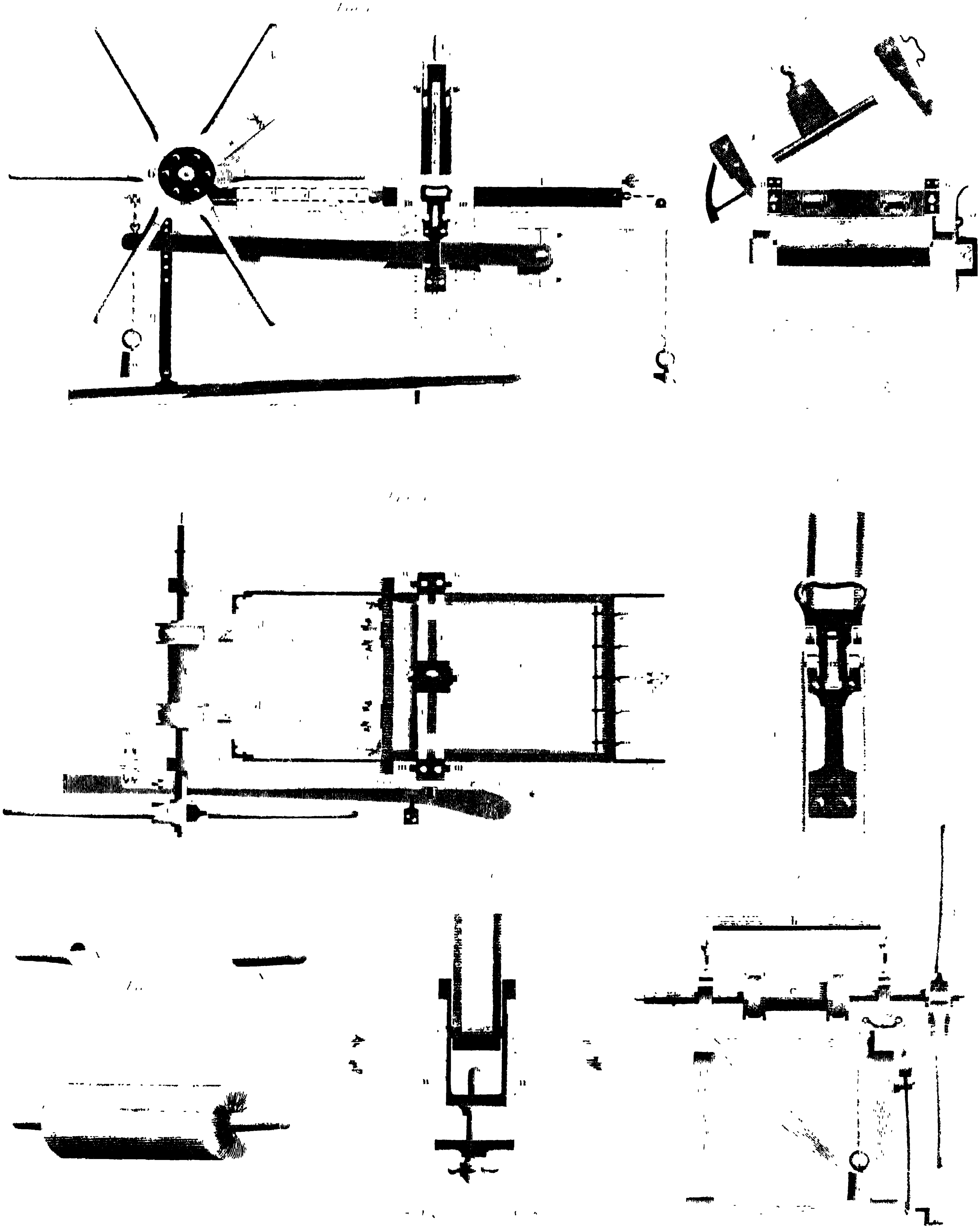
what respects the materials might be improved. This want is more particularly felt in England, where Lithography has had to contend with many prejudices; partly from the opposition it has met with from engravers, who consider it as a rival art; and partly from its having fallen into the hands of amateurs whose performances have brought it into a discredit, from which it is but now gradually recovering. (L. L. L.)

Lithography || London.

LONDON. Since the article LONDON in the *Encyclopædia* was written, the extension and improvement of the capital of the British Empire have proceeded with a rapidity equal, if not superior, to what has been witnessed at any former period.

Improvements in the City.

In the city, or that part properly called London, the increase of buildings and their improvement have not proceeded with an equal pace to what have been exhibited in Westminster, and the other adjuncts, which form a large portion of the metropolis. The private dwellings have been, indeed, much improved and augmented, principally in the environs of Moorfields, and the site which was formerly occupied by the buildings of Bedlam Hospital are now (1821) about to be covered with good dwellings. The most extensive public building recently erected within the city is the new Custom-house, with one front to the river Thames. It is upon a much larger scale than the building destroyed by fire in 1812; its interior is far better arranged for the dispatch of business, and the simple elegance of its front is an addition to the beauty of the banks of the river. The clearing away the ancient and vulgar erections which covered the legal quays between the Custom-house and London Bridge will, when completed, add much to the beauty of that part of the banks of the Thames. The New Mint, on the north-east side of Towerhill, has been completed, and displays much simplicity and taste; but from being crowded by surrounding buildings, its full effect is lost. Though attention has been paid to the exterior of this institution, yet its great excellence consists in the curious, valuable, and accurate machinery by which its operations are effected; for a full account of which, we refer to the article COINAGE in this *Supplement*. The inconveniencies of the situation, and of the scattered buildings which form the General Post-Office, have been long subjects of complaint, and at length measures have been taken for erecting a new Post-Office on a regular plan, in a more central part of the metropolis. A piece of ground situated between St Martin's le Grand and Forster' Lane, at the north-west corner of Cheapside, has been selected for the purpose, and the houses and warehouses which stood upon it have been purchased and pulled down; by which a good access to Aldersgate Street, and the northern roads from the city, has been formed. The work is at present languishing on account of some differences betwixt the Corporation of London and the Postmaster-General. The estimate of the value of the ground and buildings to be purchased was made to be L.240,000; but the actual expences incurred on those purchases has already exceeded that sum; and L.87,000 more is required to complete the payment for the whole of the ground and houses. An application was made to Parliament in July 1820, for the additional sum of L.100,000. The committee to whom the petition was referred did not approve of the prayer for the grant, and, in consequence of this state of affairs, the operation must remain suspended, till some new plan for supplying the pecuniary means is adopted by the Legislature. The Prison in the Poultry, called the Counter, has been removed. A new and more commodious edifice has been constructed near Cripplegate, capable of containing 250 delinquents, to which the prisoners have been removed, and the site of the ancient building is now covering with a spacious dissenting chapel. Among the public edifices of an inferior kind within the city that merit notice, may be mentioned the new house built on Moorfields for the London Literary Institution, to which its valuable library and apparatus have been removed. Near to it, on opposite corners of what is intended to form a new square, a very sumptuous Roman Catholic chapel, and an elegant chapel for a congregation of seceders from the Church of Scotland, have been built, the effect of which on the whole of that mass of buildings will be very good, when the plan is completed. The ancient building originally appropriated for a cloth market, known as Blackwell Hall, is now pulling down, and the corporation design building on the spot a range of offices for the Commissioners of Bankrupts, and for other purposes. One of the most striking improvements, because in Holborn, the broadest of all the streets in the city, is that which has been recently effected by removing the cumbrous front of Furnival's Inn, and replacing it with a more modern pile, covered with Bernasconi's composition, which has the appearance of Portland stone. Waterloo Bridge, Southwark Bridge, and Vauxhall Bridge, have all been completed, and opened for the public. As the particulars of their construction have been amply detailed in this work under the article BRIDGE, we must refer to it; only adding, that, from want of advantageous approaches, the tolls collected at Waterloo and Southwark Bridges are very inadequate to pay any interest on the capital that has been expended. The ruinous condition of London Bridge has been a subject of complaint for many years, and a Committee of the House of Commons has been appointed, to investigate and report on its present condition, and on the steps necessary to be taken to remove the inconveniencies suffered as well by those who pass over as by the barges and boats that sail under it. Among the improvements to the facilities of the commerce of London must be noticed the docks of the East India Company (see the article DOCKS); the West India and London Docks, and the admirable commercial road leading to the two former, by which the goods from those deposits are conveyed to the warehouses in the city. Though not strictly speaking a part of London, yet the East Country Dock, and the Surry Canal, on the southern bank of the Thames, form a vast addition to the facilities of the metropolis, and are now in a complete state to receive shipping. Though the private dwelling-houses within the city



London.

do not appear to have increased in number within the last ten years, nor have the number of windows increased, yet the value of them must have become considerably greater, as the house tax has advanced from L.86,200, in 1810, to L.103,142, in 1820.

Improvements in Westminster.

The improvements in Westminster that have been made, or that are now (1821) in progress, are very numerous and extensive, both as regards the public erections and the dwellings of individuals. The new churches, whose erection has commenced since the vote of Parliament has destined a large sum to that object, have contributed much to increase the beauty of Westminster. The parish church of St Mary-le-Bone, begun independently of the assistance of government, has been completed, and exhibits a very striking specimen of the architectural taste of the present age. Many others are in a state of great forwardness; but, as these new temples want the elegant towers which arise from the churches built by Sir Christopher Wren, they present, at a distance, less ideas of magnificence than the buildings of that great architect. The completion of the Opera-house and of the adjoining arcade has formed one part of the many additions that have been recently made, and are still proceeding, in the vicinity of the royal palace of Carlton House. Among them the most striking are Regent Street and Place, terminating with the splendid insurance-office which faces the palace. A circular street of uniform houses, with balconies supported by lofty pillars, sweeps round the insurance-office, and connects itself, at the northern extremity, with the magnificent piles of buildings on both sides of a new and wide street, which crosses Oxford Street, and terminates in the Regent's Park. When this plan shall be completed, the mass of buildings will present a group of private dwellings far superior to any thing that is to be seen in any of the other capitals of Europe. The new squares and the streets connected with them which have recently been constructed in the parishes of Mary-le-bone and Paddington, especially Montague and Brianston Squares, exhibit neat and elegant dwellings on spots either disfigured previously by being receptacles of the filth of the metropolis, or by houses of mean and dirty appearance. The estate of the Duke of Bedford has been covered with handsome streets, and that of the Foundling Hospital, near it, is now converted into Mecklenburg Square and several new streets. On the south-western side of the metropolis the same spirit of building is displayed, and Tothill-fields is being covered with houses, whilst towards Chelsea, between Grosvenor Place and Sloane Street, the ground is marked out for the construction of spacious squares and wide streets. These improvements do not, however, appear to have increased the number of the dwellings. In fact, the smaller houses have given place to larger; one of which, in many instances, has occupied the space formerly covered by several. The space covered by houses has thus been extended, and the number of streets increased, rather by the demolition of small courts and alleys, and by the new being larger than the old habitations, than by any remarkable augmentation in the number of residences. There cannot, however, be a doubt, that the improvements have tended much to the health of the inhabitants of this extended metropolis.

Improvements in Southwark.

The portion of the metropolis usually comprehended under the name of Southwark, though it forms no part of that borough, but is within the parish of Lambeth, has partaken of the general spirit of improvement which is displayed in the other portions of the capital. The most remarkable public building is that of Bedlam, a massy pile, constructed with great regard to the nature of the malady of those for whom it is destined, and not destitute of architectural taste. The Cobourg Theatre for performing musical pieces, the Asylum for the Destitute, and the School for the Deaf and Dumb, are among the new public edifices, whilst several streets have been either built, or are now building, connected with the new bridges.

House and Window Duties.

The annexed table exhibits an account of the number of houses charged to the window and inhabited house duties, with the amount of the duties in London, Westminster, and Southwark, for the years 1810, 1812, 1814, 1816, and 1818.

Years.	Places.	Number of Houses charged to Window-Duties.	Amount of Duty thereon.			Number of Houses charged to Inhabited House-Duties.	Amount of Duty thereon.		
1810	London,	14,473	L.138,881	17	11	11,380	L.86,207	18	7
	Westminster,	18,518	183,332	14	2	18,518	137,261	7	9
	Southwark,	5,655	17,326	13	6	5,431	10,935	10	11
1812	London,	14,175	136,985	6	6	14,175	86,836	12	6
	Westminster,	18,086	178,[illegible]62	2	3	18,080	141,722	5	7
	Southwark,	5,744	17,070	16	0	5,380	11,773	16	1
1814	London,	14,195	135,137	6	6	14,193	97,364	0	6
	Westminster,	18,152	177,077	10	10	18,152	146,252	18	9
	Southwark,	5,750	16,930	14	1	5,251	11,842	18	10
1816	London,	14,079	133,931	5	2	14,037	102,426	1	6
	Westminster,	18,019	173,222	12	6	18,019	145,247	2	10
	Southwark,	5,809	16,634	8	7	5,241	11,987	5	10
1818	London,	14,070	132,451	15	11	14,069	103,442	18	1
	Westminster,	17,665	179,188	13	1	17,656	148,659	11	3
	Southwark,	6,464	17,837	18	4	5,808	13,464	15	2

London. Gas Lights.

The introduction of gas lights into the streets, coffee-houses, and shops, has added much to the brilliant appearance of the metropolis at night. An incorporated company has hitherto furnished this substance, and is now increasing its establishments, whilst a new corporate body has been formed for the farther extension of this mode of lighting. Some late improvements, by which the gas may be produced from oil instead of coal, will tend to lessen the cost of the machinery, to simplify its preparation, and to adopt it for more general, if not universal use.

Fuel consumed.

The consumption of fuel may be considered as fair a criterion as any other, of the increase or decrease of the prosperity of a city. In London coal is almost exclusively used for firing, and, with the exception of a small portion brought from Staffordshire by the Grand Junction Canal, passes through the Custom-house, whose return of imports is as follows:

London.

Years.	Chaldrons of Coals.	Chaldrons of Culm.
1810	1,102,747	1344
1811	1,109,873	2229
1812	1,066,287	7842
1813	1,020,187	4653
1814	1,119,788	1896
1815	1,144,363	4272
1816	1,217,433	5815
1817	1,149,871	3879
1818	1,203,707	4738
1819	1,170,618	9479
1820	1,321,905	4461

Foreign Trade.

The general state of the foreign trade of the port of London may be gathered from the following table, which shows the number and tonnage of British and foreign ships that entered inwards and cleared outwards from and to all parts of the world (exclusive of coasters) since the conclusion of the war.

	Inwards.				Outwards.			
	British.		Foreign.		British.		Foreign.	
Year.	Ships.	Tons.	Ships.	Tons.	Ships.	Tons.	Ships.	Tons.
1814	2,773	549,307	2,297	269,834	2,248	433,099	2,193	285,816
1815	2,718	546,727	1,717	275,375	2,442	526,021	1,910	310,084
1816	2,607	512,374	792	115,163	2,448	506,453	780	129,722
1817	3,526	671,700	881	131,617	2,663	530,270	907	143,339
1818	4,455	785,473	2,198	272,656	2,974	588,819	2,008	269,585
1819	3,704	698,736	1,018	158,882	2,635	516,655	1,113	184,960
1820	3,774	699,130	856	122,619	2,589	522,573	789	122,505

Police Establishment.

Whilst the Police of the city of London has been left to the care of the municipal magistrates, all of the aldermen being justices of the peace, the vast increase of the suburbs has rendered it necessary to have establishments of a permanent nature in different quarters to prevent depredations, to detect offenders, and to protect the laws and property of the industrious and peaceable. These police offices, which have been of late years increased, are established in Bow Street, Marlborough Street, Hatton Garden, Worship Street, Whitechapel, Shadwell, Queen's Square, Westminster, and Union-hall, in Southwark. To these must be added the Thames police, having hulks in different parts of the river, fitted up as occasional prisons, from whence boats are manned, which row as guard boats through the night in the whole extent of the river, to watch the property on board the different vessels, and on the wharfs that border the water. The principal police office, that in Bow Street, is under the superintendence of a magistrate, with a salary of L.1200 *per annum*, who is in direct communication with the Secretary of State for the Home Department, and of two other magistrates with salaries of L.600 *per annum*. There are three clerks at salaries of from L.150 to L.300 *per annum*. The officers are eight in number at one guinea *per* week, of whom three have an additional salary of L.200 *per annum* each, for attendance on the royal family. There are thirteen conductors of the patroles at 5s. *per* night, and eighty-seven men under their orders and inspection, at 2s. 6d. *per* night each. The whole expence of this office amounts to about L.12,000 annually. The other seven offices are upon a lower establishment than that of Bow Street; consisting of three magistrates, with salaries of L.600 *per annum* each, of two clerks, and a less number of constables and patroles. The expences of them vary from L.3200 to L.3700 each annually. The Thames police office has three presiding magistrates at L.600 *per annum* each, two clerks, seventeen river surveyors, forty-three river constables, five land constables, and a few inferior persons. The expence of this valuable branch of the police amounts to about L.7000 *per annum*. The remaining division of the police of the metropolis is the horse patrole; a body of mounted and armed men, who pass the nights in parading the different roads in the vicinity of the metropolis. The numbers of this body are now about to be augmented, and the whole establishment to be placed on an ex-

London.

tended and improved principle. The expence of this department has usually been from L.6000 to L.8000 *per annum;* but what the increase may be under the new system about to be put in activity cannot at present be ascertained. The important branch of the police, which consists in licensing public-houses, is conducted by the county magistrates, who act gratuitously; and to them, at the petty sessions, is committed the superintendence of churchwardens, of overseers of the poor, of surveyors of the highways, and of the appointment of constables; whilst, at the quarter-sessions of the counties that touch upon the metropolis, the trials of offenders of a minor description are allotted.

London. Crimes and Punishments.

The returns of crimes and punishments in the city of London and the county of Middlesex are combined, so as to be incapable of being exhibited separately; and those in Southwark and the hundred of Brixton, in the county of Surry, though they form a portion of the metropolis, and contain one-fifth of its inhabitants, are not separately stated in the *Parliamentary Reports*, but are included generally in the list of the crimes and punishments on the Home Circuit of the Judges. We give the returns, therefore, of the trials of London and Middlesex; only remarking, that those of that portion of Surry which forms a part of the capital may be estimated at about one-sixth of the numbers that appear in these tables.

Number of Persons Committed, Convicted, Sentenced, and Acquitted in the Years

	1812.	1813.	1814.	1815.	1816.	1817.	1818.	Total.
Committed for Trial, viz.								
Males,	1,121	1,229	1,216	1,514	1,729	2,157	2,108	11,074
Females,	542	478	430	491	497	529	557	3,521
Total,	1,663	1,707	1,646	2,005	2,226	2,686	2,665	14,598
Sentences.								
Death,*	*132	*138	*158	*139	*227	*208	*201	1,203
Transportation for Life,	21	30	48	30	52	85	98	364
Ditto for 14 years,	26	39	30	32	31	50	114	325
Ditto for 7 years,	236	213	253	317	312	434	512	2,307
Imprisonment, and several to be whipped, fined, pilloried, and kept to hard labour, &c. &c.: Five years,					2			2
Three years,			1	1		2		4
Two years, and above one year,	42	30	23	19	30	25	11	180
One year, and above six months,	112	138	113	164	134	123	116	900
Six months, and under,	306	298	316	412	469	525	492	2,818
Whipping,	21	21	21	36	19	43	30	197
Fine,	102	102	61	59	110	107	93	634
Convicted,	998	1,012	1,027	1,239	1,389	1,602	1,667	8,934
Acquitted,	370	378	387	441	500	613	551	3,210
No bills found, and not prosecuted.	295	317	232	325	337	471	447	2,421
Total.	1,663	1,707	1,646	2,005	2,226	2,686	2,665	14,598
* Of whom were executed,	19	17	21	11	29	16	21	134

Nature of the Crimes of the Total Number of Persons committed for TRIAL *in the Years*

	1812.	1813.	1814.	1815.	1816.	1817.	1818.
Arson,		3	1		2		
Bigamy,	7	6	7	8	4	6	3
Burglary,	22	38	57	73	94	105	48
Cattle stealing,	1	2	3		2	2	3
—— maliciously killing,		1					1
Coin, counterfeiting the current,	3	2	4	6	16		
—— putting off and uttering counterfeit,	52	77	52	77	59	60	87
Child stealing,				3	1	5	2
Embezzlement by servants,	15	19	16	22	18	34	24
Forgery and uttering,	19	26	11	11	15	15	55
Carry over,	122	174	151	200	211	227	223

London.

	1812.	1813.	1814.	1815.	1816.	1817.	1818.
Brought forward,	122	174	151	200	211	227	223
Forged bank-notes, having in possession,	19	27	21	18	19	34	97
Fraudulent offences,	41	38	27	47	42	48	48
Horse-stealing,	6	5	7	5	9	11	16
House-breaking in the day-time, and larceny to the value of 5s.	10	9	11	12	26	30	28
Larceny simple,	1002	1002	896	1197	1229	1554	1502
Larceny in dwellings to the value of 40s.	71	69	73	80	98	93	109
——— in shops privately to the value of 5s.	44	37	34	35	22	25	35
——— on navigable rivers to the value of 40s.	7	1	3	3	5	4	4
——— from the person,	163	182	230	207	320	395	403
Letters containing bank-notes, secreting and stealing,	2	3	1	1	2	2	
——— sending threatening,	2				1		
Manslaughter,	2	4	11	5	5	7	12
Murder,	11	12	23	13	17	11	6
——— shooting, stabbing, and administering poison with intent to,	5	4	13	7	7	5	4
——— concealing the birth of an infant,						1	
Perjury,	9	7	3	7	2	9	8
Piracy,					6		
Rape,	7	6	2	7	6	5	2
—— assault, with intent to commit,	3	1	4	4	4	5	1
Robbery on the person on the highway and other places,	56	51	53	64	104	104	65
Riot and demolishing buildings,				3			
Sacrilege,					1	1	
Sheep-stealing,	1	6	2	5	5	2	10
Sodomy,	2		1	3	2	1	
——— assault with intent to commit, and other unnatural offences,	11	11	6	6	15	12	8
Stolen goods receiving,	33	34	36	34	42	54	54
Treason, high,	1	1	1			4	
Transports, being at large,	5	4	3	4	1	2	1
Felony and misdemeanour, not otherwise described,	28	19	34	38	25	40	34
Total number of persons for trial in each year,	1663	1707	1646	2005	2226	2686	2665

Nature of the Crimes of the Persons CONVICTED *in the Years*

	1812.	1813.	1814.	1815.	1816.	1817.	1818.
Arson,			1				
Bigamy,	6	4	6	5	2	4	2
Burglary,	15	22	29	41	51	44	24
Cattle-stealing,	3	1	2		2	2	1
Cattle maliciously killing,		1					
Coin (counterfeiting the current),	3	2	4	6	11		
Ditto (putting off and uttering counterfeit),	39	72	38	70	51	55	71
Ditto (having been convicted as common utterers),	3	1	8				
Child-stealing,				3		4	1
Embezzlement (by servants),	7	8	9	14	9	15	9
Forgery and uttering,	11	16	7	5	8	8	29
Forged bank-notes (having in possession), &c.	18	27	20	18	19	33	96
Fraudulent offences,	24	24	21	22	24	28	27
Horse-stealing,	2	5	4	4	7	5	11
House-breaking in the day-time, and larceny,	4	3	5	8	14	20	15
Larceny, simple,	665	607	615	809	833	1007	1027
Larceny in dwelling-houses, to the value of 40s.	28	38	40	31	52	57	62
Ditto in shops and privately, to the value of 5s.	19	18	12	22	10	12	16
Carry over,	847	849	821	1053	1093	1294	1391

	1812.	1813.	1814.	1815.	1816.	1817.	1818.
Brought forward,	847	849	821	1053	1098	1294	1391
Larceny on navigable rivers, to the value of 40s.	5	1	2		3	4	2
Ditto from the person,	73	103	121	108	185	194	185
Letters containing bank-notes (secreting and stealing),	2	2	1		1	1	
Letters (sending threatening),	2				1	1	
Manslaughter,		2	8	3	5	6	7
Murder,	4	2	8	2	6	1	3
——— (shooting, stabbing, and administering poison, with intent to),	1		5	2	1	1	
——— (concealing the birth of an infant),						1	
Piracy,				4			
Perjury,	1	1	1	3		3	
Rape,				1	1	1	
—— (assault, with intent to commit),	3	1	1	3	3	1	1
Robbery on the person on the highway,	20	15	23	15	48	47	28
Sacrilege,					1	1	
Sheep-stealing,	1	6	2	4	4	2	9
Sodomy,			1	1	2		
——— (assault, with intent to commit),	7	7	2	3	7	6	5
Stolen goods, receiving,	11	10	14	12	18	16	18
Treason, High,	1	1					
Transports being at large, &c.	5	4	3	4	1	2	1
Felony and misdemeanour (not otherwise described),	15	8	14	25	10	21	17
Total number of persons convicted in each year,	998	1012	1027	1239	1389	1602	1667

Crimes of Persons EXECUTED *who received Sentence of Death in the Years*

	1812.	1813.	1814.	1815.	1816.	1817.	1818.
Arson,			1				
Burglary,	2	1	3	1	4	4	3
Cattle-stealing,							1
Forgery and uttering,	9	11	3	4	6	5	9
Larceny in a dwelling to the value of 40s.					1	1	1
——— on a navigable river to the value of 40s.	3				2		2
Letter containing bank-notes, stealing,		1					
Murder,	4	2	8	2	6	1	3
———, shooting and stabbing with intent to,	1				1		
Piracy,					4		
Rape,				1		1	
Robbery on the person on the highway,		1	5	2	3	4	2
Sodomy,			1	1	2		
Treason, High		1					
Total,	19	17	21	11	29	16	21

Penitentiary Establishment at Millbank.

The *Penitentiary Establishment* at Millbank, originally projected by Mr Jeremy Bentham, is now nearly completed; and the experiment is fairly in progress to ascertain the practicability of producing reformation in offenders by a rigid seclusion from the scenes and companions of their crimes, by constant and regular employment, by the aid of moral instruction, and by the prospect of terminating their imprisonment at an earlier period, as a reward for their good conduct during confinement.

The plan of the institution is calculated for the reception of 1000 prisoners, viz. 600 males, and 400 females; but from the whole of the building not being completed, the numbers, when the last report was laid before Parliament (30th May 1820), were only 180 males, and 213 females. It is expected by the committee, that the whole will be completed in the year 1821. The utility of instruction and discipline is considered, by the committee, to be evinced in the moral improvement and religious impressions which the prisoners have received. As a proof of this, they have given the numbers of those who, at their own request, have been admitted to the holy sacrament, amounting, in 1819, to 40 males, and 89 females; and at Easter 1820 to 143.

London.

The establishment of officers for the Penitentiary is upon a footing nearly equal to what will be necessary when the building shall contain the full complement of 1000 prisoners. The only additions that will be required will be some few inferior turnkeys, matrons, and taskmasters.

The whole amount of expences, from the 1st January to the 31st December 1819, was . .				L. 16,023	3	10
From which are to be deducted the following sums :						
Amount of stores remaining on hand in the steward's department on 31st December 1819,	L. 1030	14	4			
Amount of stores in the master manufacturer's department, .	1135	19	10			
Monies received and outstanding, for work done by the prisoners out of the prison, .	2057	1	6			
Value of the work done by the prisoners for the use of the establishment, .	1894	7	5			
				6,118	3	1
				L. 9,905	0	9

The males are employed chiefly as tailors and shoemakers, in making great coats and shoes for the military depôt; but a large portion of the sheeting used in the prison, and some articles of clothing, are manufactured in it. The females are employed in the manufacture of straw bonnets, and in needlework; and they have nearly, from their first beginning, been in constant employment, though, from the low price which women in general receive for their work, their earnings are but inconsiderable. It appears, though the females exceed in number the males, the produce of their labour is very much less, whilst the amount of that for their domestic labour is greater.

Earnings of the men for external demand, 1819, - -				L. 1167	9	6
Earnings of the women for external demand, - - -				632	3	11
				L. 1799	13	5
Earnings of the men for domestic work,	L. 129	3	3			
Earnings of the women for the same, -	267	18	0			
				397	1	3
Total value of the labour of the prisoners in 1819, - -				L. 2196	14	8

As an encouragement to industry among the prisoners, an exact account is kept of all the work they perform; the wages are divided in the following proportions, and the prisoners, at the expiration of their confinement, are paid what is due to them on that account:

London.

Three-fourths, or fifteen shillings in the pound, or ninepence in the shilling to the establishment.—One-eighth, or two shillings and sixpence in the pound, or three halfpence in the shilling to the prisoner.—One twenty-fourth, or tenpence in the pound, or one halfpenny in the shilling to the master manufacturer, or the matron of the females.—One twenty-fourth, or tenpence in the pound, or one halfpenny in the shilling to the task-master or task-mistress.—One twenty-fourth, or tenpence in the pound, or one halfpenny in the shilling to the turnkeys and the assistant task-master or mistress, to be equally divided among them. Those prisoners who are appointed to the inferior offices of the prison, or are employed in domestic occupations, are entitled to one-fourth of their earnings, the officers having no *per* centage on their labour.

The daily allowance of food for the male prisoners is one pound and a half of bread and six ounces of meat, on four days of each week, with a less proportion for females and boys. On the days when no meat is allowed, a portion of broth is distributed, and every evening a pint of hot gruel or porridge is dispensed to them.

From the marshy nature of the ground on which the building was erected, much apprehension was entertained that it would be injurious to the health of the residents, but the reports of the committee have dispelled such fears. From February 1819 to February 1820, only three deaths occurred, one of which was from fever, and two from consumption. No case of ague had presented itself since the commencement of the establishment, and, at the date of the last report to Parliament, not a single patient in the infirmary was confined to his bed. This healthy state of the prisoners is, by the committee, ascribed to the wholesomeness of the food, to the comparative regularity of their habits, as well as to the warm, though coarse, clothing with which they are supplied, and the care taken of them during sickness.

Number of Fires, and Losses thereby.

The number of *Fires* which take place annually in so vast a city, and the losses and deaths thereby occasioned, present a curious subject of inquiry. The only information upon this subject that we have been able to procure, is contained in the *Minutes of the Evidence* taken before the Parliamentary Committee appointed to inquire into, and report upon the state of the Police of the Metropolis. "It was lately stated in an advertisement in the newspapers," says Mr Wilkinson, a gentleman examined by this Committee, "that in the last twelve years six millions of property have been destroyed by fire: I thought it a large estimate, but I mention it to the committee, because it is among the few data that I have upon the subject. I have met with another document with regard to the number of fires that are yearly in London; it is an extract from an article in the *Gentleman's Magazine* for 1807, by a person who says, 'That the Insurance Companies calculate upon an alarm of fire every day, and eight very serious fires every quarter; and from Michaelmas 1805 to Michaelmas 1806, the different fire offices in London experienced three hundred and six alarms of fires, attended with little damage; thirty-

London. one serious fires, and one hundred and fifty-five alarms, occasioned by chimneys being on fire; amounting in the whole to four hundred and ninety-two accidents in the course of twelve months.' Having given some idea of the quantity of property destroyed in London by fire, as far as I was able, I now beg leave to state the loss of lives:—It was stated lately in the papers that seventy lives were lost in the last twelve years, of course limiting the observation to the metropolis. In order to obtain some idea of the number of lives that have been lost in the last eleven years more particularly, I examined the *Gentleman's Magazines*, which I thought a good book of reference, and I now state the numbers that suffered from 1806 to 1816. In 1806 five persons suffered, three of whom were children; in 1807 six persons suffered; in 1808 one person was killed, and one was injured; this was the year in which Drury-lane was burnt, and twenty-four persons suffered by an accident, the ruins falling in upon them; in 1809 four persons were killed; in 1810 ten persons were killed, and three injured; in 1811 three persons were killed, and one injured; in 1812 none, at least none appeared in the *Magazine;* in 1813 five were injured; in 1814 three were killed; in 1815 fifteen were killed, and one injured; in 1816 four were killed, and eight injured; making a total of seventy persons killed and seriously injured from 1806 to 1816. I have no doubt but several were omitted in the account, for of course they did not profess accuracy as to the number of accidents by fire where persons suffered.—After some consideration on the subject, it is my opinion, that annually in London there are upon an average thirty-five serious fires, and that property to the amount of L.100,000 is annually destroyed, and that there is a loss annually of five lives. I have made numerous inquiries as to the number of wilful fires in London, and every one seems to concur in the idea that one-half of the serious fires are occasioned by incendiaries. I beg leave further to state, that upon no occasion has any fire-escape been used at a fire, though I have no doubt, had proper fire-escapes been used, but many lives would have been saved." *

Newspapers. The number of *Newspapers* published in London is as follows: nine daily morning and six daily evening journals. Seven papers are published three times a week. The London Gazette, and two journals in the French language, are published twice in each week. The number of Sunday papers is at present seventeen, and there are eleven other weekly papers. Two journals are published weekly, whose chief design is to criticise and give extracts from new literary works. The whole number of copies of the different journals that are distributed every week, is calculated to be about five hundred and seventy thousand.

British Museum. The last accounts presented to Parliament, relative to that splendid national establishment the *British Museum*, furnish the following results:

London || Londonderry.

RECEIPTS of all kinds, including Parliamentary grant of L.10,000, for the year ending 25th March 1821,	L.11,789	2	9
PAYMENTS of all kinds for the year ending as above,	10,699	8	6
Leaving a surplus in hand, applicable to the expences of the year ending 25th March 1822, of	L.1,089	14	

The number of persons admitted to view the Museum, from 27th March 1820 to 25th March 1821, was 62,543. †

Population. Including those parts of Surry usually termed a part of London, the population, according to the returns made to Parliament in 1811, was 1,009,546. By the returns from several districts of the metropolis which we have seen, under the census now in course of being taken, it appears that the increase in the last ten years has been at the rate of rather more than 15 *per cent.* (W. W.)

Situation. LONDONDERRY, a county in Ireland, situated between 54° 56′ and 55° 12′ north latitude, and 6° 18′ and 7° 21′ west longitude, is bounded by the ocean on the north, by the county of Antrim on the east, by Tyrone on the south, and by Donegal on the west. Its area, which is of a triangular form, is 798 English square miles, or 510,720 English acres, contained within an outline of about 158 miles. It has Lough Foyle on the north-west, and Lough Neagh on the south-east. The river Foyle, which flows into the first, and the Bann, which issues from the second, are its natural boundaries on the west and east; but the city of Londonderry, with a small district around it, is on the west side of the Foyle, and the town of Coleraine, with a similar tract, is on the north-east of the Bann. The northern side, between the Bann and Lough Foyle, is very narrow, so that the line of sea-coast does not exceed 14 miles. The boundary with Tyrone on the south and south-west is irregular, and much more extensive. Londonderry forms part of the province of Ulster, and is divided into three baronies, viz. Tyrkeerin, Kenaught, and Loughinsholin, and the half barony of Coleraine, with the towns and liberties of Londonderry and Coleraine. It contains thirty-one parishes, of which five belong to the primacy of Armagh, and the others to the diocese of Derry, which also extends into the counties of Donegal and Tyrone and a small part of Antrim.

Extent.

Divisions.

Surface and Soil. On the south and south-west the surface is generally mountainous. Another range of high grounds intersects it from south to north, in which last direction the principal rivers have their course. In the valleys through which these rivers flow, there are spots of great beauty and fertility, but of no great extent. Among the mountains which enclose these vallies, the small glens, here called *slacks*, are, for the most part, wild and desolate; yet Samhuil, the highest

* See *Second Report from the Committee on the Police of the Metropolis, ordered, by the House of Commons, to be printed,* 8th July 1817, p. 513.

† See the *Account*, &c. *ordered, by the House of Commons, to be printed,* 17th April 1821.

Londonderry. mountain, does not exceed 1600 feet. Every variety of soil is found in this county, but the most valuable kinds, which altogether occupy no great proportion of the surface, are scattered over it in small tracts. Rich loam occurs on the shores of Lough Foyle and Lough Neagh; clay, but not fertile, on the banks of the Bann, and sand in the north-west between Lough Foyle and the sea. Gravel extends over a great part of the eastern side, and also along the river Faughan on the west, and clay and gravel, which are the most common soils, along with bog, occupy a great part of the interior.

The principal rivers are the Foyle, which enters this county from Donegal, and, after a short course, passes into the lake of the same name. It is navigable for large vessels to Londonderry, and to Lifford, in Donegal, for boats of 20 tons. At the Rosses bay, on the east side of the harbour of Londonderry, there is a considerable salmon fishery. The Bann, after a course of near 40 miles, enters Lough Neagh, and then Lough Beg, and forming the boundary with Antrim for the greater part of its course, and afterwards, having the district of Coleraine on the east, falls into the sea four miles below that town. On this river also there is a valuable salmon fishery, and eels are so plentiful, that a few years ago they yielded a rent of about L. 2000. The Roe, which has its source near the centre of the county, flows north, and enters Lough Foyle through a tract of low land, which it often inundates. The Faughan rises on the south-west boundary, and taking a direction, during the latter part of its course, nearly parallel to the Foyle, falls into Lough Foyle a little to the eastward. Moyola, a considerable stream, enters Lough Neagh on the south-east. Excepting the Foyle, none of these rivers are navigable. Chalybeate springs are common, but none of them have acquired any degree of celebrity.

Minerals. The mineralogy of Londonderry has been particularly described by Mr Sampson, the author of the *Statistical Survey* of the county, to which we must refer. The Vale of the Roe separates two districts totally distinct. On the west lies the region of schist, and on the east that of basalt. Flag-stone, blue and white limestone, slate and sandstone, are the only rocks worked. Iron, either in an ochreous state, or mixed with manganese, abounds, but no coal worth notice has yet been discovered. Very fine crystals are found in the basalt, and rock crystal, said to be harder than the Kerry stone, in the schistose region. The lichen, from which cudbear is made, is found on the rocks near Londonderry, and has been long employed by the country people to give their flannels and other woollen fabrics an orange red colour.

Climate. The range of the barometer, in seven years, from 1795 to 1801, was from 28.37 to 30.84;—of the thermometer, from 17° to 81°; mean temperature 49°; the quantity of rain was from 25.7 to 34.7 inches. In the same period the number of fair days was 129 yearly at a medium. The principal winds are from the west and north-west, which blow for more than half the year. The general character of the climate is humidity, but it deserves this character rather from the frequency of the showers that fall, than from the quantity of rain indicated by the rain gauge.

Estates. With the exception of lands belonging to the church, and the towns of Londonderry and Coleraine, and certain portions reserved by the Crown to be afterwards erected into freeholds, the whole of Londonderry was granted by James I. to the twelve companies or guilds of London. The estates are therefore held from these companies, either in perpetuity, or on determinable leases. The principal proprietors or leaseholders are Lords Waterford and Londonderry, Mr Conolly, Mr Ogilby, and the families of Beresford and Ponsonby.

Farms. The average size of farms is from five to twenty Irish acres, or at a medium little more than fifteen acres English. Whole districts are subdivided into patches of seven or eight acres; but in a few situations there are farms of upwards of 300 acres. The leases are for a great many different periods, though most commonly for 21 years and one life.

Agriculture. The principal crops are potatoes, barley, oats, and flax. Wheat is not in general cultivation; turnips are very rare, and sown grasses and clovers far from being common. No uniform rotation of crops is recognised in practice, but it is usual to take two crops of oats successively, and sometimes flax the year following. Fiorin is the predominating plant in the meadows, where it grows spontaneously with great luxuriance. The live stock presents nothing worthy of particular notice. Grazing grounds are not extensive, and there are few dairies. On the east side of the Bann there are two extensive rabbit-warrens.

Manufactures. The principal manufacture is linen. According to Mr Sampson, the value of the linen bleached in this county exceeds half a million sterling, and brown or unbleached linens are exported in considerable quantities. The flax-seed is chiefly imported from America and Holland. They sow about nine pecks the English acre, if the object be to have fine flax, and little more than half that quantity when the seed is to be saved. The produce is about 160 pounds of rough flax for every peck of seed, which yields from 40 to 48 pounds of milled flax. By the hackle this is divided into nearly equal portions of dressed flax and tow. Hence the produce of an English acre may be about 180 pounds of flax and the same weight of tow, which, according to the prices given in the *Statistical Survey*, would be worth about L.18. The weavers, who are also small farmers, work at the loom little more than half the year. The finer qualities of linen are sold in the Coleraine market, and the coarser at Londonderry. In 1802 there were sixty registered bleachers, who were supposed to finish altogether about 250,000 pieces.

Commerce. Londonderry imports iron, hemp, flax and flax-seed, tallow, and tar, from the north of Europe; flax-seed, tobacco, tar, and timber from America; wine from Portugal, and coals, herrings, and other articles from Britain. During war it has sometimes had a considerable share of the provision trade. The principal articles exported are linen, beef, butter, and hides, of which the first is by far the most considerable. The trade by sea is carried on at the ports of Londonderry and Coleraine, but chiefly at the former.

Towns. The chief towns are Londonderry, Coleraine, New-

Londonderry ‖ Longford.

town-Limavady, Magherafelt, and Castle-Dawson. Londonderry has a population of about 12,000, and Coleraine near half that number. The villages are Ballaghy, Moneymore, Kilrea, and Dungiven.

Wages and Prices.

The cabins, clothing, food, and fuel of the lowest class of labourers, the cottiers, who form a great part of the population, are much the same as in the Irish counties already described. As the turbaries are fast exhausting, fuel is becoming scarce in the low country. In such situations, when the turf no longer bears to be cut, it is collected into heaps in the state of mire, baked and shaped with the hand, and afterwards spread to harden, but it makes very bad fires; and in some places, even this miserable substitute can no longer be procured but from a distance. The poor inhabitants of the coast, and in the vale of the Roe, employ three months of the year in providing fuel; coal, which is brought from Liverpool and Scotland, selling at a price beyond their means of purchasing. The wages of common labour all the year round may be from 8d. to 10d. a day; in hay and corn harvest 1s. 6d. In 1800, oatmeal, at one time, sold at 4s. 6d. *per* peck of 10 lb. avoirdupois, and potatoes were proportionally high. In 1811, potatoes were 3d. *per* stone, beef 6½d. and mutton 7d. *per* pound, oatmeal 18s. *per* cwt. Milk 2d. and butter-milk, in summer, ½d. and in winter 1d. *per* quart.

Representation.

The county of Londonderry is represented in Parliament by two members, and the towns of Londonderry and Coleraine by another for each. The population in 1790, according to Dr Beaufort, was 125,000; in 1813 it was 186,000. The inhabitants of the mountains are all Catholics, and also one-third of the people of the low country. Of the other religious denominations, the Presbyterians are the most numerous. Their clergy have salaries of from L. 40 to L. 100 from government, the dissenters from the Presbyterian church, as established in Scotland, as well as those who belong to that church.

Population.

See Sampson's *Statistical Survey of Londonderry;* Mason's *Statistical Survey of Ireland*, and the works quoted under the former Irish counties. (A.)

Situation and Extent

LONGFORD is a county in the province of Leinster, in Ireland, bounded on the north by the counties of Leitrim and Cavan, on the east and south by Westmeath, and on the west by the river Shannon, which separates it from the county of Roscommon. In its greatest extent it stretches about 25 miles from north to south, and 20 miles from east to west; and its area is 366 English square miles, or 234,240 English acres, which is divided into six baronies and twenty-three parishes. Twenty-two of the parishes are in the diocese of Ardagh, which is now united to Tuam.

Surface.

A great part of this district consists of bog, mountain, and waste. On the south, near the river Inny, there is a tract of bog extending to 36,000 acres, and towards the north the county is particularly rugged and sterile. The Inny is the only river of any note which passes through it, and that only for a short distance on the south in its progress towards the Shannon. At its conflux with the Shannon, the latter expands into a lake called Lough Reagh; the only other considerable piece of water is Lough Gawnagh, on its northern boundary, near which there are rocks of ironstone and some indications of coal. The line of the Royal Canal, from Dublin to Tarmonbarry, on the Shannon, enters Longford on the south, and passes through its south-western quarter. The climate is not more humid than that of other parts of Ireland. At Edgeworthstown, about midway between the Inny and the Shannon, the medium number of fair days, for a period of twelve years, was 140.

Longford ‖ Louisiana.

Estates.

Here, as in many other parts of Ireland, much of the land is divided into large estates of from L. 3000 to L. 7000 a year and upwards. Leases are commonly for twenty-one years and a life. Farms are, for the most part, very small where tillage is the principal object; but only a small proportion of the district is under the plough. It is chiefly occupied in grazing, in which the resident gentry almost exclusively employ the farms which they retain in their own hands.

Longford, in common with almost every county in Ireland, has a share of the linen manufacture. Being an inland county, it carries on little other commerce than the exchange of the raw produce of its soil, chiefly oats, with cattle and sheep, for articles required for the use of the inhabitants. The towns are Longford, the county town, where the assizes are held, Ballymahon, Lanesborough, Killashee, Edgeworthstown, the seat of the distinguished family of Edgeworth, Granard, and St Johnstown. None of these is so considerable as to be represented in the Parliament of the United Kingdom.

Towns.

Wages and Prices.

In 1810, the wages of common labour were 8d. a-day the year round; in hay and corn harvest 1s. 1d. Potatoes were 3d. *per* stone, beef 5d., and mutton 6½d. *per* pound, oatmeal 15s. *per* cwt., and herrings 9s. 4d. the hundred. These wages and prices seem to prove that the condition of the labouring classes is still worse in Longford than in many other parts of Ireland; and it is not easy to conceive how they find the means of rearing families.

Population.

The county sends two members to Parliament. The population in 1790, according to Dr Beaufort, was 50,100. In 1808, the Catholics were to the Protestants as eight or ten to one.

See the general works referred to under the former Irish counties, and LONGFORD in the *Encyclopædia.* (A.)

Boundaries.

LOUISIANA, an independent state of North America; the inhabitants, since its cession by France, having formed a constitution, and been admitted a co-state of the Federal Union. The western boundary of this state, which threatened to become an object of serious contest between the Spanish government and that of the United States, has been at length finally settled, by the same treaty which stipulated the cession of the Floridas. The river Sabina is now fixed on as the boundary between this state and Mexico, in the centre of which is the line of division. This line, including all the islands in the river, proceeds to the thirty-second degree of latitude; from thence, quitting the river, it is continued due north to the thirty-third degree of north latitude; from thence it extends due east, crossing the Red River, till it strikes the Mississippi. That

river continues to be its eastern limit, till it reaches the Iberville, when the line passes through the middle of it, and of Lake Ponchartrain to the Gulf of Mexico; which bounds it on the southern side to the mouth of the river Sabina. All the islands in the Gulf of Mexico, within three leagues of the shore, are included in this state.

The boundaries thus defined are those over which the state of Louisiana, according to the decision of Congress, and the definitions of its own constitution extend, but is far from including the whole of that vast tract of country which was ceded to America. When first ceded, that portion which is now the state of Louisiana was denominated the "Territory of New Orleans;" and that portion which now is denominated the state of Missouri was called the "Territory of Louisiana;" but the rapid peopling of these vast districts has made it necessary to adopt more definite descriptions; and as the settling of the waste increases, and new states are created, the subdivisions, which will be necessary, will give birth to new names for those various districts which were once called by the general name of Louisiana.

Extent and Population. The state of Louisiana, as thus defined, extends over 49,000 square miles; and though it has rapidly increased since the union with the Federal Government, the population is much thinner than in any of the other states. By the census taken in the year 1810, the whole number of souls was only 76,556, of whom 34,660 were negro slaves, and 7585 free persons of colour.

Since that period no accurate accounts have been made up, but in the latter end of 1818, the inhabitants were estimated to be about 110,000, though, whether the white or the black race has experienced the greatest proportionate increase, is not ascertainable by any returns we have seen.

Revenue The revenue of this, like the other states of America, is divided into two branches, that destined for the support of the local, and that for the support of the general government. The first of these is not known beyond the limits of the state, but the latter will sufficiently show the relative wealth of Louisiana, as compared with the rest of the union. During the war with England, internal taxes were levied through the states; in 1814, these in the whole produced 3,273,990 dollars, of which Louisiana furnished 33,522; and in the following year, when the whole sum was 6,369,272, the share of this state was only 59,150. The whole net revenue which was produced by the custom-houses of the United States, in 1815, was 37,656,486 dollars, of which Louisiana supplied 984,909.

and Shipping. The whole shipping of the United States employed in foreign trade, in 1815, was 854,294 tons, and that of Louisiana was 13,766 tons; the whole shipping employed in the coasting trade was 435,066 tons, of which only 2577 tons belonged to this state.

This view of the statistics of Louisiana shows most clearly that it is chiefly an agricultural country, whose inhabitants, though possessed of abundance of land, have no more capital than is barely sufficient to enable them to produce as much as they themselves consume. It will appear singular, that whilst the foreign trade has produced one thirty-seventh of the whole of that branch of national revenue, the internal taxes have amounted to less than one hundredth. This is to be accounted for by observing, that the city of New Orleans, the capital of the state, is the entrepot for the foreign commerce of all the western states; and that the exportable productions of Kentucky, of Ohio, as well as of the other newly formed communities, whose population amounts to nearly one million, have no other place of export. Whatever of European, of West Indian, or of Asiatic commodities, are required by the inhabitants on the banks of the Mississippi, of the Ohio, or the Missouri, must pass the custom-house of New Orleans, and pay there the duties that are imposed by the general legislature. Without this view of the commerce of Louisiana, it would appear that the sums collected by the custom-house alone, independent of the state taxes, would amount to a larger sum *per* head than is paid by the inhabitants of the richest country in Europe. If, from the population, the slaves are deducted, the taxable inhabitants cannot exceed 70,000; and as the general and state taxes amount to at least 1,250,000 dollars annually, each of the individuals would contribute L. 4 sterling *per* year for the maintenance of government, which is nearly double as much as is paid by the inhabitants of Great Britain and Ireland, four times as much as is paid in France, and six times as much as is paid in the other kingdoms of Europe.

Constitution and Division. The state of Louisiana is divided into twelve counties, for the better arrangement in the choice of the legislature: these are,

The County of Orleans,	Rapides.
—— German Coast,	Natchitoches.
—— Acadia,	Concordia.
—— Iberville,	Ouachita.
—— Lafourche,	Oppelousas, and
Pointe Coupee,	Attakapas.

This division was made in 1812, when the constitution by which the state is governed was first framed. A majority of the convention by which the constitution was enacted was of French and Spanish extraction; but the system decreed assimilates very much to that of the other states in the union, having a governor and two assemblies, of different degrees of duration and property, all elected by those inhabitants who pay taxes. The judiciary department consists of subordinate courts, and a supreme court, with only appellate jurisdiction; the judges of which hold their office during good behaviour, and are only removable on the addresses of the legislative bodies, three-fourths of whose members must concur in the vote. All the elections, as well as the resolutions of the legislative bodies, are determined by ballot. The press is free, but the printers and publishers are accountable for what they issue. No religion is established, nor any provision made for public worship, nor is there any law to prohibit theatrical performances, or the open exercise of trades on the Lord's day. Clergymen, priests, and teachers, of whatever religious sect, are excluded from the legislative assemblies, nor are they eligible to any office of profit or trust under the state.

New Orleans. The city of New Orleans, the capital, contains between 25,000 and 30,000 inhabitants, more than half

Louisiana. of whom are negroes, or people of colour. It has vastly increased since the cession to the United States, and its growth of population is rapidly advancing. It stands on the eastern bank of the Mississippi, about 110 miles from the sea, and is in 30° north latitude. Though it is unfortified, yet it is capable of presenting formidable obstacles to the progress of an invading enemy; and it is most favourably situated for the enjoyment of commerce. Being built on a narrow isthmus, bounded on one side by the river, and on the other by impassable morasses, it is difficult to be approached. The mouth of the river is defended by an almost impregnable fort; and, higher up, where the river describes nearly a circle, called *Detour des Anglois*, two strong castles are constructed on the opposite banks, which can effectually impede the progress of a hostile fleet. The direct passage by water to the city is through several channels, which the waters of the Mississippi have forced through the land at its mouth. The most considerable of these is obstructed by a sand-bank, over which no vessel can pass with safety that draws more than seventeen feet of water; and though, when this bar is passed, the depth of water is sufficient for the largest ships, yet it is so encumbered with the huge logs constantly carried down by the stream as to be a navigation of considerable peril. The danger is increased by the number of trees, of the heavier kinds of wood, that are sunk to the bottom of the river, which render the anchorage everywhere insecure, and in consequence of which the vessels that are detained waiting for a favourable wind prefer being moored by cables, attached to the trees on the shore, to trusting their security to anchors on the ground. Besides this passage through the mouths of the Mississippi, the city of New Orleans has a communication with the ocean, by the Lakes Borgne and Pontchartrain. A natural canal, called the Bayoute of St John, extends from the morasses within two miles of the city, to the latter of those lakes, but it is only navigable for vessels drawing less than six feet water. It is, however, through this channel, that a communication is maintained between New Orleans and the northern parts of West Florida. The only other towns yet known as such in Louisiana are Natchioches, with about 600 inhabitants, on the Red River; Natchez, on the east bank of the Mississippi, in latitude 31°, 33′, with 2500 inhabitants; and Washington, about six miles to the east, with 1000 inhabitants.

Mississippi. The Mississippi usually overflows its banks for about one hundred and fifty miles above New Orleans. The floods commonly begin in April, when the meltings of the ice from the Missouri make their appearance. The increase continues till the end of June, when the waters gradually subside; and, in August, the stream is confined to the ordinary channels. Artificial embankments have been constructed, and are vigilantly watched during the increase of the river; but, in spite of all efforts, the force of the stream sometimes opens a passage for it, and the country becomes inundated to a very considerable extent. It is remarked by those well acquainted with the peculiarities of this river, that whenever an inundation takes place, as it generally covers a tract of country from one of the sinuosities of the river to another, the quantity of mud which is deposited raises the surface of the land several feet, so that it is less liable to be overflowed in succeeding years, and the deposit becomes the most fertile of soils. The right banks of this stupendous river are higher than the left, and the land on the western side is least subject to extensive inundations, but it is also the least fruitful. Louisiana.

The country to the westward of the Mississippi, between that river and the Colorado, or Red River, and to the westward of that last stream, is intersected with numerous lesser rivers, which in some parts form extensive lakes. In the valley through which the Red River runs is the best land in the state. Tobacco and indigo are cultivated there with great success, and the cotton grown is of the best quality of any produced within the United States. The principal settlements, for they are undeserving the name of towns, are Natchioches, Bayou-Rapid, Bayou-Boeuf, Bayou-Robert, and Atchafalaya. Opelousas, separated from Attakapas by a natural canal, which connects the rivers Teche and Vermillion, enjoys a good but very tenacious soil, on which cotton is cultivated with success, and some sugar is raised. Maize is grown for the inhabitants, and vast herds of cattle are bred on the extensive natural meadows. The number of the cattle belonging to some individual proprietors is very great; several mark annually from one to two thousand calves. Face of the Country

The settlers of La Fourche are usually that class denominated by the French *petits habitants*, small proprietors who occupy their own lands; but there are some extensive plantations belonging to richer individuals, to whom the smaller cultivators are giving place, and are removing to new and unexhausted soils. Sugar plantations, which can only be established advantageously by capitalists, have of late increased considerably. The settlers between La Fourche and the canal are principally of Spanish origin, and speak but little French. They are a more indolent and less enterprising race than the French Creoles; are careless about the conveniencies of life, and their dwellings display a much greater appearance of poverty than is exhibited by their French and English neighbours. That part of Louisiana called the Coast, or more properly the German Coast, between Pointe Coupee and La Fourche, is the most pleasant and most flourishing portion of the state. For near 100 miles on the banks of the river plantations are to be seen, with only short intervals between them. These present to view some beautiful woods of evergreen oak, of laurels, firs, pines, and prodigious weeping-willows, and are intermixed with extensive groves of orange-trees. In descending the river, the smaller proprietors and the white inhabitants gradually diminish in number, so that near the capital the traveller sees ten negroes for one white man, and remarks that the appearance of the country more resembles the islands in the West Indies, than the other parts of the United States. The dwellings in this district are generally wooden frame work of one story, but tolerably furnished with conveniencies; and the sugar-houses, at distant intervals, are distinguishable by the columns of thick smoke which continually issue from them. Agri-

Louisiana.

The productions of the state of Louisiana capable of furnishing the materials of commerce, are so similar to those of the West India Islands, that, like them, the future growth of the state must depend on the increase of the negro population. As the slave trade is prohibited in the United States, as well as in the English, French, and Dutch settlements, the natural increase of the blacks is the only dependance on which the agriculture can rely; and whilst the inequality of the sexes continues, such increase cannot take place. Sugar cannot be made in Louisiana cheaper than in the settlements on the coast of Guiana, nor so cheap as in the viceroyalties of Mexico and New Granada, or in the extensive dominions of Brazil. It is not, therefore, very probable, that Louisiana, notwithstanding the sanguine speculations of the North Americans, will be able to contend on equal terms in the markets of Europe, with the numerous competitors they will have to encounter. The climate, though it admits of the growth of wheat, and the other grains of Europe, at the most northern parts, yet does not produce it with that uniform increase which is experienced in Kentucky, and the newly erected States of Illinois and Missouri; and as the transit by steam-boats to New Orleans is very easy, the corn wanted for the consumption of Louisiana can be drawn cheaper and better from these districts, than it can be cultivated at home. Maize and rice are raised with facility, sufficient for the domestic consumption, and furnish the principal aliment to the negro slaves.

Inhabitants.

The basis of the population is French. The inhabitants speak that language, though very corruptly; and in spite of the absence of intercourse with European France during the lapse of three generations, they still retain the quickness, the cheerfulness, and a portion of the politeness of the country from whence they sprung. There are, however, considerable mixtures of Spaniards and Germans amalgamated with the French families, and the whole formed a race, who, with little to stimulate exertion, with very imperfect means of instruction, and with no attention awakened to political investigation, were very ill prepared to receive the republican regimen of the United States. Their religion was the Roman Catholic, to the fasts, and festivals, and ceremonies of which, at least, they were rigidly attached, and the neglect of which, among the Anglo-Americans, made their incorporation with them very tardy and reluctant. At the present day, even according to the accounts of the citizens of the United States, they are murmuring against the government, and indulging sorrow at the change. Much difficulty has arisen from the claims on the land made by the Commissioners on the part of the Federal Government. Under the government of Spain the land was of small value, extensive grants were easily obtained, and as the titles were not likely to be disputed, the evidences of those titles were not very carefully preserved. The commissioners appointed by the S[illegible]s to ascertain those rights are generally accused of great want of liberality, and of discovering a leaning against the claimants. The harvest to the American lawyers, from these disputed titles, has drawn to Louisiana many members of that profession; and as the common [illegible] of England, as adopted in the United States, is not easily reconciled to the laws of Spain, which before regulated property in Louisiana, few decisions are made without much delay, great expence, and the bitter complaints of the ancient proprietors, who had been accustomed to a more simple and speedy mode of administering justice. The trial by jury, valua[illegible] as it is to a people whose customs and manners h[illegible] been formed by it, is not easily introduced to practical advantage among those who are unaccustomed to it; and the inhabitants of Louisiana neither comprehend its importance or utility, seeing it, as they do, administered by judges who are equally strangers to their language and local customs.

Louisiana.

The number of the Aborigines bordering on Louisiana, though much diminished, is still considerable. About thirty-five years ago, the ravages of the small-pox extended to some very distant tribes, and produced an enormous degree of mortality, but since that period they are stated to have been again on the increase. The conduct of the government of the United States towards these uncivilized people has been almost uniformly cruel and unjust, according to the testimony of their most decided panegyrists. The transactions with the Osage Indians may be taken as a specimen of this conduct, and we have the authority of Mr Brackenridge for the narrative. "A purchase was made a few years ago by Governor Lewis, of the greater part of the country claimed by these people (the Osages), reserving to them the privilege of hunting on it. Great dissatisfaction has been excited among them in consequence of the purchase, which they allege not to have been fairly made. In fact, this is not a matter easily effected with strict correctness, and it is doubtful if any of our extensive Indian purchases were conducted in the fairest manner. A desire of doing something meritorious may have induced our agents to go too far in procuring the consent of the chiefs of the nation, and perhaps of chiefs created *by themselves* for the express purpose. This purchase was sanctioned by the Government of the United States, but the money stipulated to be paid to the Indians was not paid to them. At the end of two years they were informed that the payment was soon to be made. Upon this thirty or forty of the Indian chiefs repaired to the American Governor, and in council remonstrated against the purchase, declaring it to have been unfair. The principal speaker, with much natural eloquence, stated, 'That he was much surprised to hear of this purchase, which had been forgotten by his nation, and, he supposed, had also been forgotten by his great father (the President). The sale was made by those who had no authority, and his great father not having complied with his part of the bargain, by delaying two years the payment, and not performing the other parts of the treaty, his nation ought not to be held to their part of it, even if fairly entered into. But,' said he, "the Osage nation has no right to sell its country, much less have a few chiefs, who have taken it on themselves to do so: our country belongs to our posterity as well as to ourselves; it is not absolutely ours, we receive it only for our lifetimes, and [illegible] to transmit it to our descendants. Our great father is

Louisiana. good and just, will he permit his children to sell the bones of their fathers, to sell the inheritance of their children? No, keep your goods, and let us keep our lands.' The American Governor coolly told the Indians that the President did not compel them to [illegible] their lands, but when they sold them, the bargain must be kept; that payment had been unavoidably delayed; that part of the purchase was ready, which, if they chose, they might accept, if not, it was of no consequence, the land would still be considered as purchased, and their resistance would have no other effect than that of displeasing the President. Finding that opposition was useless, they finally promised to use their influence to induce their nation to accept." Mr Brackenbridge reluctantly confesses that these purchases are not less unjust than the French and Spanish mode of taking the land without saying any thing about it, and then keeping these people quiet by presents, more pleasing to them than if given as the payment of a debt, for which an equivalent had been previously received.

The whole of the trade with the Indian tribes may, *communibus annis*, furnish peltry to the amount of 150,000 dollars; it is divided between the British traders of Canada and the traders of America, and is the cause of more jealousy between the two nations, than the whole, if undivided, would justify. It is worthy of remark, that these Indian tribes have names, which seem either to have been recently given to them, or perhaps known to the white race rather than to themselves. The names are altogether different from those by which they were distinguished when the first Europeans traversed the country. Monsieur de la Sale, and the survivors of his unfortunate expedition, who penetrated from the Gulf of Mexico to Canada, in the years 1685, 1686, 1687, and 1688, and visited most of these tribes whose names they registered, have mentioned scarcely a single nation by the name it now bears; neither can the same or similar names be found in the writings of the other early French travellers, Le Clerc, Torty, and Hennepin. The manners of these Indians seem to be but little changed by their intercourse with the white race, and though fire arms have been very generally diffused among them, they have made no other alteration in their mode of carrying on war with each other, beyond that of substituting muskets in the place of bows and arrows.

Climate. The climate of Louisiana partakes, in an excessive degree, of those great variations which seem to characterize the whole of North America. The extremes of heat and cold are greater than in the same latitude within the Atlantic states. At New Orleans, the different degrees of cold experienced in two succeeding winters, is frequently greater than is felt in the old continent in a difference of latitude of six or eight degrees. The 30th degree seems, however, to be the boundary of snow in this country, which is a perfect level. In ordinary winters, the ponds and stagnant waters to that limit are rarely frozen, though frost in a slight degree is experienced almost every year at New Orleans. A little to the north of the 30th degree, on lands scarcely more elevated, snow frequently falls, and at Opelousas, in the year 1807, it continued on the ground more than a week, though it is only in latitude 30° 32', being on the banks of the river in which the fall of water does not exceed one foot in a mile; its elevation, allowing for the sinuosities of the stream, cannot be more than sixty or seventy feet above New Orleans, where, at the same time, the clouds discharged their waters in the form of rain. In the upper part of Louisiana, the winters are more severe than in the same latitudes in the Atlantic states. The thermometer, even in latitude 38°, is often for weeks together from 12° to 15° below zero. The heat of summer is equally excessive, the thermometer frequently from June to August remaining almost stationary, during some hours of each day, as high as 96°. The sudden changes, from the extremes of heat to those of cold, are so rapid, that in a few days from 78 above to 10 below 0, have been remarked as the variations in the thermometer. The north-western part of Louisiana, as it approaches nearer to the rocky mountains, suffers the most severely by the cold of winter. From these excessive variations of climature, combined with the miasmata exhaled from the marshy delta, which extends from the bounds of Florida to the limits of Mexico, the whole of this state may be considered as very unhealthy. Diseases of the intermitten kind everywhere prevail, and in New Orleans, a bilious fever, highly inflammatory, is, if not constantly, yet periodically experienced.

Productions. Although the exportable commodities of Louisiana are but of small amount when compared with the great extent of country, and the numerous people that have no other maritime outlet; yet it is naturally capable of furnishing productions of various kinds, which will contribute to the comfort of its inhabitants, and might be made the means of beneficial commerce. Sugar, cotton, and rice, have already been noticed among its productions. Indigo has been cultivated and manufactured, but cannot compete with what is now brought from Bengal and from Guatimala, to the markets of Europe; so that there is no ground to calculate on a great increase. Tobacco seems to be an indigenous plant, as the use of it generally prevailed among the natives when the first Europeans visited the country. What is produced has, when cured, a peculiar flavour which has not been yet relished by those who either smoke, chew, or take snuff. In the capricious rule of fancy, it may however at some time prevail, and if so, will be of vast consequence to the country, as it can be grown with comparatively little expence. Very little wine is yet made in this state; not enough for the consumption of the capital, though most of the planters provide it for their own families. The indigenous grapes are much improved by cultivation, especially two species which are not found in any other part of the United States, the *Vitis æstivalis* and the *Vitis riparia*, the latter of which is a very fine grape. On the borders of the savannahs a grape is found resembling that of Burgundy. A wine made from it, if exposed to the sun in summer, and to the cold in winter, becomes much improved, and is not liable to turn sour. Fruits of various kinds abound. The mulberry grows spontaneously, and

from experiments made upon a small scale, it is clearly ascertained that silk-worms might be easily reared, if the high price of labour did not operate as an impediment. Hemp and flax are found wild, of great length, and of tenacious fibre, but little or no attention has been paid to the cultivation of those plants. Hops also are very abundant in a wild state, but have scarcely received any attention. Plumbs grow in vast quantities, and some of most exquisite flavour. Among other species, one known by the natives as the prairie plum (*Prunus chickasa*), literally covers tracts of ground of many acres in extent, and produces fruit so abundantly as to bend the trees down to the ground with their weight. The persimmon, or, as the French call it, the placminier, is abundant; it somewhat resembles our medlar, but its taste is sweet, and more delicate. When quite ripe, the natives squeeze the fruit over a fine sieve, to separate the pulp from the kernels and skin. The pulp, which is a kind of paste or pap, is then dried in ovens, or in the sun, and is formed into cakes a foot in length, about half a foot broad, and half an inch thick.

This bread is very nutritious, will keep good a long time, but being of a very astringent quality, cannot safely be eaten in large quantities. The papaw trees are found in abundance, and loaded with fruit to a most excessive degree ; the bark is highly acrid, but the pulp is both pleasant to the taste and very wholesome. Orange and citron trees were long ago introduced from the island of St Domingo, and produce as good fruit as in their native soils; but the rind of the orange being very thick, it is better calculated for preserving, which is performed to a very considerable extent. Peach and fig trees were early introduced from Carolina. The peaches are of the kind called Albergers, grow as large as the fist, and yield a juice from which both wine and brandy are made. The peach stones are planted in February, and without any farther trouble the trees yield, at least, two hundred peaches the third year, and double that number the six or seven following years, when they cease to bear, and then decay. As new trees are so easily raised, the loss of the old ones causes no regret. The figs are of two kinds, blue and white; they grow to a large size, and are of a good flavour. Wild apples, pears, and cherries, are found, but they are observed to run more to wood, and to produce less fruit than in colder climates. The olive trees grow to a large size, and are sometimes thirty feet from the ground before their branches shoot out ; though they are thus more beautiful than the olive trees of the south of Europe, they bear less fruit, and no oil is yet made from them, only the fruit is gathered to be eaten green. Walnut trees, hicory nuts, filberts, and chesnuts, are found in many parts of the country, and with a little attention the fruit of them might be easily increased.

The forest trees most common in Louisiana are white and red cedars, the durable nature of whose wood has induced the settlers to use it generally in building their houses. The cypress is still more durable, and grows to a very large size, so that canoes are frequently made from a single tree, which will carry sixteen or eighteen tons. The bark of the large trees of this species is very valuable as a covering for the houses of the poorer people. The magnolia, the maple, from which sugar is made, the cotton wood tree, the locust, the holm oak, four kinds of live oak, the elm, the ash, and the beech, are abundantly spread over the country. On the sandy soils near the coast, there are extensive tracts covered with pines, which are used, but not to a great extent, for the purpose of extracting turpentine, tar, and pitch, which may become valuable articles of commerce as the population increases. The myrtle tree, affording wax, is one of the most valuable of the forest trees of Louisiana. It resembles the laurel in appearance, but grows to a much larger size, and its leaves of the same form are of a deeper green. Its fruit grows in bunches, on a stalk about two inches in length. A small pod, containing a kernel within a nut, is covered with the wax, which is separated by the simple process of pouring boiling water upon it, when the wax floats on the top of it. The wax is of two kinds, one a yellowish white, the other a dark green. It may be bleached in six or eight days, is harder than bees-wax, and therefore better fitted for the warm climates, where, in the Catholic churches, it is much used for the large tapers that decorate the altars. When the Spaniards held Louisiana, considerable quantities of this wax were exported to the islands of Cuba and Hispaniola.

Minerals.

As the mineral productions of Louisiana have hitherto been but slightly examined, we must receive with much hesitation the report of their riches. Sanguine speculators in every unexplored country anticipate the discovery of gold and silver mines, and the slightest reports of indications of these metals are readily converted into convictions of their existence. It is very probable that in the district to the north-west of this state such mines may be found, but it is not probable, whilst human labour is so dear, that they can be worked to any profit. Copper, zinc, iron, sal-gem, and coal, have been sufficiently ascertained to exist, but none of them are worked. The only mineral actually produced is lead. The most considerable mines are worked by the two Indian tribes the Saukees and the Foxes, in a very imperfect mode; but in some years they have produced from 250 to 300 tons of lead. These Indians are ill provided with the proper implements, using generally the common hoe, with which they clear away the soil for a few feet, when the ore is found resembling the state of stones in a quarry. It is smelted in the rudest manner, being laid on piles of wood which are kindled, and the lead, as it is melted, runs into various forms. It is then suffered to cool, and in that state sold to the American traders, who make it into pigs by using the proper moulds for that purpose. The principal district for the production of lead is, however, to the north of the boundary of this state, on the banks of the Mississippi, and within the newly created state of that name. In 1814, those mines employed about 350 persons, and yielded between 700 and 800 tons of lead, so that they are worked to very little advantage, when labour is so high as in the United States.

Wild Animals.

Among the wild animals of Louisiana, the bears are very numerous in the winter season, when they come from the north in a very lean state, as they do

Louisiana.

not quit these regions till they are covered with snow. After remaining some time in this country, where the abundance of nourishment soon fattens them, they become very indolent, and take up their residence in some hollow tree, where, when discovered, they are easily taken by the inhabitants, who highly value the oil which they extract from them. These bears are not carnivorous, and, unless wounded by him, will not attack a man, but when they have been assailed and hurt, they have pursued the assailant and squeezed him to death, though without attempting to feed on the body. The *grizzly bear* is seldom seen so far south as this state, nor does the race appear to be very numerous, even in the more northern parts of the continent. It is the enemy of man, and appears to thirst for human food. It grows to an enormous size, and has the property of scenting his prey, so as to pursue a hunter for an hour after he has passed. The American travellers Lewis and Clark give the dimensions of one killed by their party, in crossing the continent. Its length was 8 feet 7½ inches, round the neck 3 feet 11 inches, round the fore-leg 1 foot 11 inches, and the length of the talons 4⅜ inches. This animal, when full-grown, commonly weighs from 800 to 900 pounds, and has been known to attain the weight of 1200 pounds. He does not, like other bears, climb the trees, and thus the Indian hunters find a means of escape, when pursued by him. Wolves are found in the northern and western parts of the state; they are of much smaller size than the same animal of the old continent, and are not ferocious; they more resemble the native dog of America, and differ but little, except in not barking. The buffaloes have withdrawn towards the interior, and are now rarely found in Louisiana. Deer of various kinds are abundant on the borders, and are hunted by the Indians rather for the sake of the skins than of the flesh, but the value of skins having lately declined, the hunting has consequently much diminished. The prairie dog, or squirrel, is a gregarious animal, occupying large tracts of land, which are filled with its burrows. It has a cloven lip, like the rabbit; the hair is short, and of a light grey colour. It makes a noise not unlike the barking of a small dog, and though, when first taken, it is extremely fierce, it is easily domesticated. The habitations of these animals are in elevated situations, as it wants no water, but subsists on the grass that grows near its burrows, where it passes the winter months in a sleeping state. The *Gopher* bears considerable resemblance to the mole, but is twice as large; its jaw has a bag, or pouch, in which it carries its food, and removes the dirt when he makes his habitation. The mounds thrown up by this little animal are frequently three or four feet in height. The cameleon is very common, as well as various other lizards, and the scorpion and tarantula are sometimes found.

The most common of the feathered tribes in the woods are the wild turkeys, which stalk about in numerous flocks, but avoid the open tracts of land. A beautiful bird, called the Prairie Hen, is seen in large flights. It comes to the barn yards, and frequently alights on the houses of the villagers. It is larger than the pheasant of the United States, though resembling it in its colours; it differs, however, from it in being much more easily domesticated, nor is the flesh of so good a flavour. Another bird, which has not yet received a name, bears, in appearance, a great resemblance to the pheasant, but is nearly as large as the wild turkey, which is generally double the weight of the domestic turkey of England. Partridges and quails are met with in great abundance; and, in the autumn and winter, the lakes are covered with wild-fowl, ducks, geese, swans, cranes, widgeon, teal, and a variety of others.

Fishes.

The river Mississippi abounds with fish, but the lower part of it is of such great depth that they can only be caught with hook and line. The carp of this river grows to an enormous size, being seldom less than two feet, and sometimes exceeding four feet in length. The higher up the river they are caught, the more they are prized. Barbel are sometimes taken four feet long; the flesh is delicate and good, and in taste resembles the cod of the Banks of Newfoundland. The whole of the rivers abound with cray fish, and the dikes constructed to impede the inundations are frequently so perforated by them as to be exposed to destruction. The shrimps, a diminutive shell-fish, is found on those lakes which sometimes communicate with the sea, as thick as a man's little finger, and three inches in length, and is highly esteemed by epicures. The Burgo-Breaker, an excellent fish, is usually a foot or eighteen inches long, perfectly round, with scales of a gold colour. In its throat are two bones, with a surface like that of a file, with which it breaks the coats of the shell-fish on which it feeds. The Choupic, of the trout species, the Sardine, a kind of pilchard, and the Patassa, a sort of mullet, are very abundant, and much esteemed. The sea-coast abounds with all the varieties which are known in the tropical regions, especially turtles of all the different species, and oysters in great abundance.

History.

The country of Louisiana was first visited by the Spaniards, who included it under the general denomination of Florida, in the year 1512. Ponce de Leon, who was the earliest explorer, seems not to have been informed of the magnitude or connections of the river Mississippi, first made known in France by Verazzani, a native of Italy, who visited that country in 1523. No attempt was made to settle it till 1562, when Admiral de Coligny deeming it a suitable place of refuge for the persecuted Protestants of France, equipped an expedition, under Jean de Ribaut. It proceeded only to the spot now known as Savannah, in Georgia, was prevented by the Indians from penetrating to the Mississippi, and, after great disasters and sufferings, returned to France. A second expedition, under René de Laumadere, was dispatched to the same point by Coligny, in 1564, which, after enduring hardships similar to the former, was on the point of reimbarking for Europe, when the former commander, Ribaut, made his appearance on the coast, with new recruits, and abundance of supplies. The attempt of the French to settle that country excited the jealousy of Spain, and a force was dispatched to dislodge them. The Spaniards, after taking a fort, executed all the garrison, and affixed, on the scaffold

Louisiana. where the barbarities were perpetrated, an inscription that the victims were killed not as Frenchmen, but as heretics and enemies of God. A French officer, De Gourgues, afterwards recaptured the fort, and executed similar cruelties on the garrison, with the inscription that they were destroyed not as Spaniards, but as murderers and cut-throats. The attention of France seems to have been withheld from this colony till about the year 1672, when it was first known in Canada that the river of Foxes ran into a mighty stream, which emptied itself into the Gulf of Mexico. Little, however, was done to explore the course of the river from Canada till the voyage of La Salle, who, after descending the Mississippi, returned to France. He procured the direction of a force, which left Rochelle in 1684, reached the mouth of the Mississippi, and, after building a small fort there, fell a sacrifice to the mutinous dispositions of his own followers. No further notice seems to have been taken of this country by France till about the year 1699, when Iberville reached the river, and ascended it as high as the Natchez. The name of Louisiana was given to the country by that commander, instead of the name of Florida, which both sides of the Mississippi had before borne. The settlement and cultivation of the colony made a very languid progress from the return of Iberville in 1700 till the year 1712, when the government and a monopoly of the commerce of the country was granted to Crosat, who, finding it unaccompanied with profit, relinquished his privilege in 1717. It was thus again at the disposal of the crown, and became the foundation or rather pretext for that project of the celebrated Law which ultimately involved France in such calamities. M. Bienville was appointed governor under the company of the Indies, and selected the spot on which the city of New Orleans stands for the capital of the colony. The war from 1719 to 1721 between France and Spain was extended to this part of the globe, and various events of that warfare tended to check the progress of the settlement, and when peace was restored, the internal dissensions and the animosity of the warlike Indian tribe of the Natchez prevented a rapid increase of prosperity. As late as the year 1736 the establishments were few and inconsiderable, being confined to some settlements at New Orleans, Beloxi, and the Mobile. The war with England, which terminated in 1763, had deprived France of Canada, and Louisiana having thus become of comparatively little value, was ceded by France to the crown of Spain, which, with the greatest reluctance on the part of the inhabitants, obtained possession of it in 1765. It remained under the government of Spain till it was ceded to France by the treaty of St Ildefonso, confirmed by that of Madrid, in 1801. As, from the war between France and us, she could not avail herself of the cession, it remained under the Spanish government till Bonaparte sold it to the United States. Commissioners from France received it from the Spaniards, and instantly delivered it over to the Anglo-Americans in 1803; a short time after which it was formed into an independent state of their union.

The war between Great Britain and the United States having given rise to a variety of predatory incursions on the Atlantic side of America, which compelled the government to adopt a most watchful and expensive state of preparation, was at length directed to Louisiana. The capital, New Orleans, commanding the only channel of communication between the newly-founded and rapidly increasing communities in the western territories, was deemed by the British government a place of sufficient value to warrant the equipment of a most formidable expedition to secure its possession. It is situated on an oblong island on the left bank of the Mississippi. The approach to it was by a pass, about one thousand yards across, below the city, which was defended by the Americans, who had thrown up a hasty line of entrenchments upon it, supported by batteries, and having its flank defended by a fort on the opposite bank of the river. As the fortifications at the mouth of the river forbade the entrance of our fleet, there was no access to the American lines but by passing the army through a series of lakes in open boats. These lakes were defended by a small flotilla of Americans, which was captured or destroyed by a superior force of armed boats from our fleet, and thus a passage was opened for the army to the point to be attacked. The American forces, under General Jackson, were at first very few in number, and for the most part consisted of militia; but during the continuance of the operations, the organised inhabitants of Kentucky and of the other districts bordering on the Mississippi, gave them a numerical superiority, and in the effect of their fire demonstrated that they were equal, if not better markmen than their assailants. With the British every thing depended on promptitude and decision, with the Americans every delay was of vast benefit. During the preparations for the grand attack the command of the British army had passed from General Keane to General Gibbs, and from him to General Sir Edward Pakenham, from which changes some delay seems to have arisen. The British troops arrived before the American lines on the 24th December 1814, after fatigues and privations of the most severe kind. A continued skirmishing was kept from that period till the 8th of January, in which the British, from their more exposed situation, suffered more severely than the Americans. The attack on the lines of the Americans was made with great vigour in front, whilst a detachment of the army was passed over the Mississippi, and captured the fort that flanked the line of defence. Owing to some confusion in the party appointed to convey the fascines and the scaling-ladders, delays occurred of which the Americans behind their entrenchments most ably availed themselves. Two British generals fell in the attack, the carnage among the troops was dreadful, and at length a retreat was ordered. The officer on whom the command had devolved, seeing but little hope from a renewed attempt, determined on abandoning the enterprise. The forces were withdrawn from the island by the same passages through the lakes by which they had reached it, and having joined the fleet on the coast, were very soon after made acquainted with the termination of the war between Great Britain and the United States. The loss to the British army was very

great, for out of betwixt seven and eight thousand men brought into the field, not fewer than two thousand fell. The loss on the American side appears, by their accounts, to have been very inconsiderable.

See Pitkin's *Statistical View of the United States.* Duyckinck's *Constitutions of the United States.* *Louisiana*, par M. le Page du Pratz. Brackenridge's *Views of Louisiana.* James' *History of the American War.* Stoddart's *Louisiana.* (W. W.)

Situation and Extent

LOUTH is a maritime county in the province of Leinster, in Ireland, containing 329 English square miles, or 210,560 English acres, divided into four baronies and sixty-one parishes. It has the Irish Sea on the east, the counties of Armagh and Down on the north, Meath on the south, and Monaghan and Cavan on the west. From Carlingford bay on the north to Drogheda bay on the south, the distance is about 26 miles. Between these two points, the inland boundary describes the segment of a circle, the greatest distance of which, from the coast, is about 20 miles. Dundalk bay runs up towards the centre of the county, and diminishes its breadth one-half at the town of that name.

Surface and Soil.

Louth has mountainous tracts towards the north, between Dundalk and Carlingford, and on the confines of Armagh; but in other parts the surface is marked by only gentle inequalities, or hills of no great elevation. It is in general fertile, with but little waste land, and no considerable lakes; and is embellished by a number of gentlemen's seats, among which, that of Mr John Foster, on his domain of Collon, is the most magnificent. "No place in the island," says Mr Wakefield, "is more worthy of notice." The Flurry, the Lagan, the Fane, and the Dee, are the principal streams that flow through it, all of them from west to east. The Boyne, for a short distance, washes its south-eastern boundary. Limestone, marl, and slate, are the only fossil substances worked at present; the first is far from being general. Lead was formerly worked on the Lagan, near the sea-coast, and is supposed to exist in the mountains which separate this county from Armagh.

Estates and Farms

This district is divided into estates, worth from L. 1500 to L. 2000 *per annum.* Only two or three are of greater value. Farms are, in general, larger than in most other parts of Ireland; but there are still many very small; in some parishes, scarcely one above 25 acres, and in others they seldom extend to 80 acres. The average rent, in 1809, was from 30s. to 31s. the Irish acre, or about 18s. 6d. the English; but it has increased since, several considerable farms having been let within these five years at from three to five guineas the Irish acre. As the land is chiefly occupied in tillage, little attention is paid to the improvement of cattle and sheep; of the latter, though a few are kept on most farms, the number is inconsiderable. Wheat and oats are the principal corn crops, barley being very little cultivated. The other crops are potatoes, flax, and a little hemp. Clover and turnips are almost confined to the farms of proprietors. It is only on these that the general management is good; that of the common farmers being, for the most part, slovenly, and their lands requiring heavy dressings of lime and marl to keep them productive. Yet many of the tenants are in easy circumstances, well clothed, use meat in their families, and in every thing but their houses and farm buildings are in a condition superior to that of their brethren in most other parts of Ireland. It is common to renew the leases some time before the old ones expire, so that the tenants are not often changed; but fines are frequently paid on these renewals, which carry away much of the capital that should be applied to the soil. Tithes are very seldom taken in kind; their value is ascertained about the end of harvest, and the tenants grant their notes for the amount, which, though payable in November, is in some cases not exacted till almost twelve months after.

Wages and Prices.

In 1816, the wages of common labour were about 1s. a day, and from 1s. 8d. to 2s. in hay and corn harvest. Cotters had only 6½d. but they had a cabin, half an acre of land, and grass for a cow, for L. 2, 10s. It is to be regretted, that the writers of Mason's *Parochial Survey*, from which these rates are taken, do not also give the prices of provisions. In 1811, according to Mr Wakefield, potatoes were 3d. *per* stone, oatmeal 19s. 3d. *per* cwt. and beef 6d. and mutton 7d. *per* pound. Coal is used among the better sort of farmers, but the most common fuel is turf, and among some of the poorest cottars only furze. Mr Wakefield saw a number of women upon the fields, between Collon and Dundalk, gathering dry dung to serve them as fuel; and this practice, he adds, is common over all the county.

Manufactures

Louth carries on the linen manufacture to a considerable extent. About 2000 acres have been under flax in some years, and in one year 11,590 bushels of seed have been saved. This quantity of seed is much greater than is produced in any other county of Ireland. Dowlas, sheetings, and other fabrics, are made to a great amount, and sold at Drogheda, from whence they are sent, partly in an unfinished state, to the English markets. At Collon they make linen of various qualities, part of which is also sold unbleached. The weavers earn about 2s. or 2s. 3d. a day. Cambrics have long been manufactured at Dundalk. The cotton manufacture, also, was in a flourishing condition at Collon when Mr Wakefield wrote; 1300 looms being employed in calico weaving by two individuals in that neighbourhood, at wages nearly the same as those of the linen weavers. A stocking factory has also been established at Collon.

Towns

The towns are Drogheda, Dundalk, Carlingford, Dunleer, Ardee, and Collon. Drogheda, situated on the north bank of the Boyne, which is navigable to the town, its liberties extending into the county of Meath, is a place of considerable trade, with a population of 15,000. Large quantities of corn are shipped here for the English market, particularly for Liverpool, which lies nearly on a line with it on the opposite coast. The battle of the Boyne is commemorated by an obelisk erected on the banks of the river, at the second milestone from this town on the road to Slane. Dundalk, the shire and assize town, though its harbour is not so good as that of Drogheda, is a place of importance both for its

trade and population. At Dundalk, Edward, the brother of Robert Bruce of Scotland, was proclaimed King of Ireland, the last of its resident monarchs, if his short and precarious dignity entitle him to the name. Carlingford, situated on the bay of that name, is an inconsiderable place; its harbour being unsafe in rough weather, is little frequented by shipping except for the export of butter. Dunleer and Ardee, though parliamentary boroughs before the Union, have been many years in a state of decay. Collon, which owes much of its increase to Mr John Foster, is now a considerable village, pleasantly situated on the highly ornamented domain of that gentleman.

Representation and Population. Louth county returns two members to Parliament, and the towns of Drogheda and Dundalk one each. Lord Roden and Mr John Foster have a commanding influence both in the county and in the borough of Dundalk. In 1790 the population was 57,750, in which, according to Mr Wakefield, the Catholics are to the Protestants as fifteen to one. Much of the personal property belongs to the former, and considerable estates are held by Lord Southwell and other Catholics. Two Catholic gentlemen are called on the grand jury. From the increase in some of the parishes, described in the *Parochial Survey*, it is probable that the population of this county had increased considerably, perhaps one third, since 1790.

See the general works referred to under the former Irish counties, and the articles LOUTH, DROGHEDA, and DUNDALK, in the *Encyclopædia*. (A.)

LUC (JOHN ANDREW DE), a natural philosopher of great merit and celebrity, born at Geneva, 8th February 1727, was the son of James Francis de Luc, descended from a family who had emigrated from Lucca, and settled at Geneva, in the fifteenth century.

His father was the author of some very respectable publications in refutation of Mandeville, and other sceptical writers; and he had the means of giving his son an excellent education, although he found it convenient to establish him in a commercial engagement, which principally occupied the first forty-six years of his life, without any other interruption than that which was occasioned by some journies of business into the neighbouring countries, and a few scientific excursions among the Alps: during these, however, he collected by degrees, in conjunction with his brother William Antony, a splendid museum of mineralogy and of natural history in general, which is still preserved at Geneva by the younger Deluc, his nephew. He took, at the same time, his share of the public business of the state, as one of the council of 200, and he is still remembered with respect by his fellow citizens, though he revisited them but once, and that for a few days only, after his emigration, which was the consequence of some unexpected misfortunes in commerce. He bore them with fortitude, and he rather rejoiced than lamented at the change of his pursuits, when he removed to England in 1773. He was made a Fellow of the Royal Society in the same year, and was appointed Reader to the Queen; a situation which he continued to hold for forty-four years, and which afforded him both leisure and a competent income. In the latter part of his life he obtained leave to perform several tours in Switzerland, France, Holland, and Germany; in this last country he passed six years, from 1798 to 1804; and after his return he undertook a Geological Tour through England. When he was at Gottingen, in the beginning of his German Tour, he received the compliment of being appointed Honorary Professor of Geology in that University; but he never entered on the active duties of a professorship. He was also a Correspondent of the Academy of Sciences at Paris, and a member of several other scientific associations.

His favourite studies were geology and meteorology. The situation of his native country had naturally led him to contemplate the peculiarities of the earth's structure, and the properties of the atmosphere, as particularly displayed in mountainous countries, and as subservient to the measurement of heights. He inherited from his father a sincere veneration for the doctrines of Christianity, and a disposition to defend the Mosaic account of the date of the creation, against the incredulity of the age. His royal patroness was most anxious to encourage and promote his labours in this field; and he is universally allowed to have had great success in removing the specious objections which had been advanced by his antagonists, against the comparatively recent formation of the present continents. The testimony of Cuvier is sufficient to establish his character in this capacity, and to place him, at the same time, in the first rank of modern geologists. His original experiments, relating to meteorology, are, however, not less valuable to the natural philosopher; and he discovered many facts of considerable importance relating to heat and moisture. He noticed the disappearance of heat in the thawing of ice, about the same time that Black founded on it his ingenious hypothesis of latent heat: he ascertained that water was more dense about 40° of Fahrenheit than at the temperature of freezing, expanding equally on each side of the maximum: and he was the original author of the opinion lately readvanced by Mr Dalton, that the quantity of aqueous vapour, contained in any space, is independent of the presence or density of the air, or of any other elastic fluid; though it appears difficult to reconcile this opinion with some of the experiments of our author's great rival, Saussure, a philosopher who, as he very candidly allows, made, in many respects, more rapid progress in hygrometry than himself. Deluc's comparative experiments on his own hygrometer, and on Saussure's, show only that both are imperfect; but it may be inferred from them, that a mean between both would in general approach much nearer to the natural scale than either taken separately. It appears also probable, that Saussure's is rather less injured by time than Deluc's, which has been found to indicate a greater degree of mean moisture every year than the last.

He was a man of warm feelings, and of gentle and obliging manners, fulfilling on all occasions the various duties of a husband, a father, a master, and a friend; at the same time, that his literary and scientific merits, and his unremitting attention to

Luc. the service of the Queen, ensured her respect and her kindness; he saw her daily for many years, and in his last illness, which was long and painful, she showed him repeated marks of benevolent regard. He died at Windsor, on the 7th of November 1817, leaving a variety of works, which will long be remembered in the scientific world.

1. *Recherches sur les modifications de l'atmosphere*, 2 v. 4. Geneva, 1772. 4 v. 8. Par. 1784. Containing many accurate and ingenious experiments on moisture, evaporation, and the indications of hygrometers and thermometers, applied to the employment of the barometer in the measurement of the height of mountains.

2. *Relation de differens voyages dans les Alpes de Faucigny*, 12. Maestricht, 1771. Written principally by Dentand, who accompanied the two Delucs in these expeditions.

3. *Account of a new hygrometer*. *Phil. Trans.* 1773, p. 404. Like a mercurial thermometer, with an ivory bulb, which expanded by moisture, and caused the mercury to descend.

4. *Rules for measuring heights by the barometer*. *Phil. Trans.* 1774, p. 158. The first correct rules that had been made public.

5. *Barometrical observations on the depth of the mines in the Harz*. *Phil. Trans.* 1777, p. 401. Examples of the application of the rules.

6. *An essay on pyrometry and areometry*. *Phil. Trans.* 1778, p. 419. A paper containing many valuable remarks on physical measures in general.

7. *Lettres physiques et morales sur l'histoire de la terre*, 6 v. 8. Hague, 1778. Dedicated to the Queen; relating particularly to the appearances of mountains, and to the antiquity of the human race; explaining the six days of the Mosaic creation as so many periods, preceding the epoch of the actual state of the globe; and attributing the deluge to the filling up of cavities, supposed to have been left void in the interior of the earth. The whole work is intermixed with interesting observations on men and manners.

8. *A second paper concerning some barometrical measurements in the mines of the Harz*. *Phil. Trans.* 1779, p. 485.

9. *Lettres sur quelques parties de la Suisse*. 8. 1781. Also addressed to the Queen.

10. *Nouvelles idées sur la meteorologie*. 2 v. in 3. 8. Lond. 1787. A very valuable collection of observations and experiments, including some original remarks on electricity.

11. *Several papers on hygrometry, on vapour, and rain, on meteorology in general, on expansion, and on refraction*, in Rozier's *Journal de Physique*, XXX., XXXII., XXXVI., XXXVII., XLIII.

12. Some letters *On the physical history of the earth*, in the *Monthly Review*, enlarged, especially June 1790, and Vol. II. Appendix.

13. *On hygrometry*. *Phil. Trans.* 1791, p. 1, 389. In one of these very important papers, the whalebone hygrometer is described.

14. *On evaporation*. *Phil. Trans.* 1792, p. 400. Among the fundamental principles laid down in this paper, the independence of vapour and air is asserted.

15. *Lettres sur l'histoire physique de la terre*. 8. Par. 1798. Addressed to Professor Blumenbach, and published by Mr Emery, a clergyman at Paris. The substance had already appeared in the *Journal de Physique* for 1790, 1791, and 1798. We find in this volume an essay written for a prize at Haarlem. in 1791, but without success, *On the existence of a general principle of morality*. It contains an interesting account of some conversations of the author with Voltaire and Rousseau. Luc.

16. *Lettres sur l'education religieuse de l'enfance*, 8. Berlin, 1799.

17. *Bacon tel qu'il est*. 8. Berlin, 1800. Showing the bad faith of the French translator, who had omitted many passages favourable to revealed religion.

18. *Précis de la philosophie de Bacon*. 2 v. 8. Par. 1802. Giving an interesting view of the progress of natural science.

19. *Lettres sur le Christianisme*, Berlin and Hanover, 1801, 1803. A correspondence with Mr Teller.

20. *Introduction à la physique terrestre par les fluides expansibles*. 8. Par. 1803.

21. *Traité élémentaire sur le fluide galvanique*. 8. Paris, 1804.

22. *A paper on lavas*. *Journal des Mines*, cxv. Nicholson, XX.

23, 24. Several articles in the *British Critic*, and in the *Monthly Magazine*.

25. *Traité élémentaire de géologie*. 8. Paris, 1809. Also in *English*, by Delafite, the same year. This volume is less strictly introductory to geology than the *Lettres sur la terre*. It is principally intended as a refutation of the Vulcanian system of Hutton and Playfair, who deduced the changes of the earth's structure from the operation of fire, and attributed a higher antiquity to the present state of the continents than is required in the Neptunian system, adopted by Deluc after Dolomieu.

26. He sent to the Royal Society, in 1809, a long paper *On separating the chemical from the electrical effects of the pile*, with a description of the *Electric column and aerial electroscope*; in which he advanced opinions so little in unison with the latest discoveries of the day, especially with those of the present President of the Society, that the council probably thought it would be either encouraging error or leading to controversy to admit them into the *Transactions*. He had, indeed, on other occasions, shown somewhat too much scepticism in the rejection of new facts; and had never been convinced even of Mr Cavendish's all important discovery of the composition of water. The paper was afterwards published in Nicholson's *Journal* (XXVI.), and the dry column described in it was constructed by various experimental philosophers. It exhibited a continual vibrating motion, which was made more sensible by the sound of a little bell, struck by the pendulum at each alternation; and the vibration was more or less rapid, according to the state of the atmospherical electricity, and according to other circumstances affecting the column; but the motion ceased at last, after a continuance of several months, or perhaps years. There are also papers in Volumes XXI. XXII. XXVII. XXVIII. XXXII. XXXIII. and

Luc || Lucimeter.

XXXV., mostly *On electricity and galvanism*, together with one on *hygrology*, a *Letter to Bode on comets*, and a fanciful theory of the origin of the *Heat derived from compression*; some of them are dated from Ashfield, near Honiton, in Devonshire.

27. In the *Philosophical Magazine*, Volumes XXXV. XLII. XLIII. and XLV., there are also some papers *On electricity and geology*, especially on that of *St Michael's Mount*, of *Vesuvius*, and of *Northumberland*; and a note *On the sympathetic vibrations* of the pendulums of two clocks, placed near each other.

28. *Geological travels in the north of Europe*. 8. Lond. 1810.

29. *Geological travels in England*. 2 v. 8. Lond. 1811.

30. *Geological travels in Switzerland and Germany*. 2 v. 8. Lond. 1813.

31. *An "Abridgment of geology*, published in 1817," when he was in his ninetieth year, is mentioned as one of his best works; but it seems to have been only a republication or a translation of some former treatise, perhaps the *Traité élémentaire*.

[*Philosophical Magazine*, Nov. 1817. Monod and Weiss, in *Biographie Universelle*, XXV. 8. Paris, 1820.] (O. R.)

LUCIMETER.—This name has been given to an apparatus employed by Bouguer for measuring the intensity of the light which proceeds from different bodies.

In the case of two lamps or candles burning near to each other, the intensity of the light may be compared, by comparing the intensity of the shadows of an adjacent body. The shadow produced by interposing the body in the stronger light is darker than its shadow, formed by the interposition of the body in the rays of the weaker; because the first shadow is enlightened only by the light it receives from the weaker light, whilst the other shadow is more strongly enlightened by the light from the stronger light. But this method will not serve for comparing the intensity of the light of the sun and moon, for the light of the sun so greatly exceeds the other, that when both sun and moon are visible at the same time, the light of the moon is far too weak for any shadow to be formed by intercepting it.

For the purpose of measuring and comparing the intensity of the light of the sun and moon, Bouguer reduced the light of the sun and of the moon till the light appeared to be equal to that of a candle. The eye is able to judge whether or not two lights are equal; but if the lights are unequal, it is impossible to estimate by inspection how much the one exceeds the other. Being able to calculate how much he had reduced the light of the sun and of the moon, he was enabled to say what proportion their light bore to that of the candle.

For the former, Bouguer, when the sun was at an elevation of 31 degrees above the horizon, received the light into a dark room, through a hole of $\frac{1}{12}$ of an inch in diameter. In this hole was placed a concave glass to weaken the light, by making the rays diverge more than they would in passing through the hole without a concave glass. He received the image formed by the divergent rays at a distance of five or six feet, by interposing a skreen, which formed a right section of the cone of divergent rays: this right section was a round image of the sun, of $\frac{108}{12}$ of an inch in diameter; therefore the light was diminished by the square of that number 11,664, since the light received through a hole of one line in diameter was diffused over a circle of 108 lines in diameter, and of 11664 times the area. This light he found equal to that of a candle placed at a distance of 16 feet.

Lucimeter.

He employed the same concave glass to receive the light of the full moon; the moon being nearly at its mean distance from the earth, and at 31 degrees of altitude; the same altitude as the sun had in his observation of that luminary. The light of the moon being weak, he received the image at $\frac{6}{12}$ of an inch from the concave glass, and then the light of the image was so weak as to be equal to the light of a candle at the distance of 50 feet.

Now the light of the moon was diminished in the proportion of the square of one to sixty-four, which is the square of the diameter of its circular image. If the light of the moon had been diminished 11,664 times, it would have been equal to the light of the candle removed to a distance of 675 feet; for as 8, the diameter of the image, is to 50, the distance, so is 108 the diameter of the image when the light is reduced 11,664 times, to 675 feet, the distance of the candle, which would produce that degree of light. Therefore the light of the sun being equal to that of a candle placed at the distance of 16 inches, and the light of the moon being equal to the light of the same candle placed at the distance of 675 feet, that is, 8100 inches, it follows that the light of the sun is to the light of the moon as 65,610,000, the square of 8100, is to 256, the square of 16. This experiment gave the light of the sun 256,289 times greater than the light of the full moon. Bouguer had results somewhat different from other experiments, and taking a mean of these results, he concludes that the light of the sun is 300,000 times greater than the light of the full moon. The light of the moon, when collected into a focus by a concave mirror, which condenses the light into a space 306 times less than the natural state of the light, produces no sensible heat.

Bouguer found, by a process similar to that above described, that the light of the full moon, when elevated 66° 11′, was to the light of the full moon elevated 19° 16′ above the horizon, as 2500 the square of 50, to 1681 the square of 41. The sun at the harbour of Croisic in Brittany, where Bouguer made his experiments, has the same apparent altitudes of 66° 11′ and 19° 16′ at the summer and winter solstices; and he concludes that the intensity of the light of the sun at the summer solstice is to the intensity of its light at the winter solstice, in the above mentioned ratio of 2500 to 1651, or about three to two. He found that the light of the moon when near the horizon, and about to set, was 2000 times less than the light of the moon elevated 66° 11′. This difference in the light of heavenly bodies, when at different altitudes, proceeds from the want of transparence in the air; for when the heavenly body is not much elevated above the horizon, the rays proceeding from it have a greater distance of atmosphere to pass through

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than the rays from the same body at a greater altitude; and the rays from a heavenly body in the zenith proceed in the direction of a diameter, and therefore traverse the atmosphere by the shortest path. Bouguer calculates that the mass of air passed through by the rays from a heavenly body at 66° 11′, is equal to a supposed mass of air of the uniform density of the air at the surface of the earth, 4275 toises in thickness; and that the mass of air passed through by the rays from a heavenly body 19° 16′ in altitude, is equal to a supposed mass of air of the density of the air at the surface, and of 11,744 toises in thickness.

He concludes that light is diminished $\frac{810}{2500}$, or about $\frac{1}{3}$, by passing through a mass of air of the uniform density of the air at the surface, and 7469 toises in thickness. The rays from a heavenly body near the horizon are likewise impeded by the terrestrial vapours, which vary in density, and render the intensity of the light of a heavenly body at the horizon various at different times. The same cause renders the quantity of the refraction of the heavenly bodies at the horizon uncertain.

In certain states of the air, the discs of the sun and moon, when at the horizon, appear somewhat elliptic; the apparent vertical diameter being less than the horizontal. This is occasioned by the greater refraction of the air through which the under limb is seen; which refraction elevates the apparent place of the under limb, by a quantity sensibly greater than that quantity of refraction by which the upper limb is raised. This alteration of figure, and the colour of the rising and setting sun and moon, indicate the greater or less quantity of vapour diffused in the air, and are usefully referred to by the seaman and farmer as prognostic indications of the weather.

The existence of a greater or less quantity of vapour mixed with the air is also indicated by the different degrees of intensity of the blue colour of the sky. Some are of opinion, that this colour depends on the colour of the mass of air which forms the atmosphere; others maintain, that it arises from the darkness of space seen through the interposed atmosphere. The blue colour of the sky increases in intensity from the horizon to the zenith, and is particularly intense when seen from the elevated parts of the Alps, because in that situation there are few terrestrial vapours mixed with the air, and it is the white colour of these vapours which renders the blue less intense in lower situations. For the purpose of estimating and noting its intensity, it is compared with different tints of blue painted on a card, as described under the article CYANOMETER.

See *Essai d'optique sur la gradation de la lumiere*, par Bouguer; and *Voyage* de Humboldt—*Relation historique*, Chap. III. p. 251. (Y.)

LUS, a district in the eastern part of the Persian province of Mekran. It is of a circular form, and bounded on three sides by an immense range of mountains. The face of the country is flat and sandy, producing abundant crops of every species of grain. There are four passes through the mountains, two of which lead into Sinde, one into Mekran, and one into Balouchistan. The present chief, Jam Meer Mahomed Khan, can bring into the field 4000 irregular troops, and draws a revenue of 50,000 rupees. The different towns and districts are governed by petty chiefs, independent in their district, though owning the supremacy of Mahomed Khan. The capital is Bayla, but the chief maritime port is Sommeany. Lus is supposed to be the country of the ancient Oritæ.—*Edinburgh Gazetteer, or Geographical Dictionary.*

MAL

MALUS (STEPHEN LEWIS), the discoverer of the Laws of the Polarisation of Light, born at Paris, 23d June 1775, was the son of Anne Lewis Malus du Mitry, and of Louisa Charlotte Desboves, his wife.

His father had a place in the Treasury of France, and gave him an excellent education at home in mathematics and in the fine arts; as well as in classical literature, with which he rendered himself so familiar, as to retain many passages of the *Iliad* in memory throughout his life. At seventeen he was admitted, after a severe examination, as a pupil of the School of Military Engineers; and about the same time he amused himself with writing a regular tragedy in verse on the death of Cato. He soon distinguished himself in his military studies, and he was about to obtain a commission as an officer, when an order of the minister Bouchotte imputed to him the offence of being a suspected person, probably on account of the situation held by his father, and he was dismissed from the school. He was then obliged to enter the army as a private soldier in the 5th battalion of Paris, and he was employed in this capacity on the fortifications of Dunkirk. Here he was soon distinguished by Mr Lepère, the director of the works, as superior to his accidental situation; and he was selected as one of the young men who were to constitute the members of the *Ecole Polytechnique*, then to be established upon the recommendation and under the direction of Monge, who immediately chose him, from a previous knowledge of his merit, as one of the twenty that were to be made instructors of the rest. This body constituted, at that moment, the only refuge of the sciences in France, and the enthusiasm of its members was proportionate to the advantages which they enjoyed, and to the importance of the trust committed to them. In the three years which he passed in this institution, he was

Malus.

much employed, among other applications of the higher geometry, in pursuing the mathematical theory of optics, a department of science in which he was afterwards so eminently to distinguish himself by experimental discoveries. He was then, however, obliged to abandon for a time the pursuit of scientific investigations, and he was admitted into the corps of engineers, with the seniority of his former rank in the school. He served in the army of the Sombre and Meuse; he was present at the passage of the Rhine in 1797, and at the affairs of "Ukratz" and Altenkirch. While he was in Germany, he formed an engagement with Miss Koch, the daughter of the Chancellor of the University of Giessen, and he was on the point of marrying her, when he was obliged to join the Egyptian expedition. He was present in that campaign, at the battles of Chebreïs, and of the Pyramids; he was at the affair of Sabish, at the siege of El Arish, and at that of Jaffa. After the surrender of that place, he was employed in the repairs of the fortifications, and in the establishment of military hospitals. Here he was attacked by the plague, and fortunately recovered from it without any medical assistance. He was then sent to fortify Damietta; he was afterwards at the battle of Heliopolis, at the affair of Ceraim, and at the siege of Cairo. After the capitulation with the English, he embarked on board of the transport Castor, and arrived in France the 26th October 1801. His health was exhausted, and his spirits were broken, by fatigue and anxiety; but his attachment to his betrothed bride was undiminished, and he hastened to Germany to fulfil his engagement: his fidelity was rewarded, during the eleven years that he survived, by the most constant and affectionate attention on the part of his wife; and she died a year or two after him, a victim to the same disease which had been fatal to her husband.

He had, however, enough of strength and vigour of constitution remaining, to enable him, besides the official superintendence of the works carrying on at Antwerp and at Strasburg, to pursue the study of his favourite sciences; and upon occasion of a prize question, proposed by the Institute, he undertook the investigation of the extraordinary refraction of Iceland crystal, which the experiments of Dr Wollaston had lately shown to agree very accurately with the laws laid down by Huygens; and besides completely confirming all Dr Wollaston's results, he had the good fortune greatly to extend the Huygenian discovery of the peculiar modification of light produced by the action of such crystals, which Newton had distinguished by the name Polarity, and which Malus now found to be produced in a variety of circumstances, independently of the action of crystallized bodies. It seems natural to suppose that the investigation of the laws of the internal reflection of light, at the second surface of the crystals, must have led him to the discovery of the effects of oblique reflection in other circumstances; but according to Biot, there was more of accident in his actual progress; for he informs us that Malus had been looking through a piece of crystal at the image of the sun, reflected from the windows of the Luxembourg, to the house in the Rue d'Enfer, where he lived, and that he was much surprised to find one of the double images disappear in a certain position of the crystal; although the next day, at a different hour, he could no longer observe the phenomenon, from the alteration of the angle of incidence.

The merit of his discovery was soon acknowledged by his election as a Member of the Institute, as well as by the adjudication of a Biennial Medal from the Royal Society of London, on the foundation of Count Rumford. It has been thought creditable to the Royal Society to have conferred this distinction in the time of a war between the two countries; but if any credit were due for only doing justice conscientiously, it would attach, on this occasion, to those members of the Council, who saw their own optical speculations in great danger from the new mass of evidence, which appeared likely to overthrow them, at least in the public opinion, and who were still the most active in offering this tribute of applause to the more fortunate labours of a rival.

Nor was the remuneration of Malus confined to empty honours only; he obtained promotion, from the liberality of the French government, *in his own profession* AS A MILITARY MAN; and this not for services performed in the field, nor even in a difficult and dangerous expedition to unknown regions, but for experiments made with safety and tranquillity in his own closet. That government had not carried the refined principle of the division of labour so far, as to have resolved that all public encouragement should be limited to the precise department in which a public service had been performed; and a mark of distinction, which a gentleman could accept without degradation, was not deemed an incommensurate remuneration for a discovery in abstract science. Such a refinement, which has been practically introduced in our own matchless country, might appear, to a man who had a heart, something worse than sordid; he might fancy that a great nation, as well as a great individual, should treat its dependents, "not according to their deserts, but after its own honour and dignity:" if, however, a person in office happened to have any thing like a heart about him, the outcry of an indiscriminating opposition would soon teach him to silence its dictates.

1. Mr Malus's first publication appears to have been a paper *On an unknown branch of the Nile*, in the first volume of the *Décade Egyptienne*. 2. He presented to the Institute a mathematical *Traité d'optique*, before the completion of his experiments on double refraction; it was published in the *Mémoires présentés à l'Institut*, II. 4. Paris, 1810. 3. His more important discoveries were first made known in the second volume of the *Mémoires d'Arcueil*, 8. Paris, 1809; and again, 4. in the *Theory of double refraction*. *Mém. prés. à l'Inst.* II. a paper which obtained a prize the 2d January 1810. 5. In a short *Essay on the measurement of the refractive force of opaque bodies*, contained in the same volume, he employs the method, before made known by Dr Wollaston, for conducting the experiment, and computes the forces concerned upon the Newtonian hypothesis; applied, however, in a manner somewhat arbitrary to the circumstances of the problem. 6. *Remarks on some new optical phenomena*. *Mém. Inst. Sc.* 1810,

p. 105, Paris, 1814, read 11th March 1811. This paper is principally intended to prove that two portions of light are always polarised together in opposite directions, and that no part of the light concerned is destroyed, "as Dr Young had been inclined to suspect;" the author found that light transmitted obliquely through a number of parallel glasses at a proper angle, becomes at last completely polarised. Mr Arago had discovered a case which appeared to be an exception to the general law of the polarisation of transmitted light, but it was afterwards readily explained from the theory of the production of colours by interference, as applied to transmitted light. A letter, containing the substance of this paper, was published in Thomson's *Annals*, III. 257, Apr. 1814, on occasion of some discoveries of Dr Brewster, which had been supposed to be wholly new. 7. *On phenomena accompanying refraction and reflection*, p. 112; read 27th May, showing the universality of polarisation at a proper angle, and examining the effect of a metallic surface. 8. *On the axis of refraction of crystals*, p. 142; describing an apparatus for finding the properties of bodies with respect to polarised light, applied to the determination of the axis of crystals, and to the examination of the structure of organized bodies, which appear in general to have certain axes of polarisation, as well as those which are manifestly crystallized.

The zeal and energy of Malus supported him to the last, not only in the continuance of these interesting investigations, but also in his duties as an examiner at the *Ecole Polytechnique*. He died, 24th February 1812, universally regretted by the lovers of science in all countries, and deeply lamented by his colleagues, who said of him, as Newton did of Cotes, that if his life had been prolonged, we should at last "have known something" of the laws of nature.

(Delambre, *M. Inst.* 1816, P. XXVII. Biot in *Biographie Universelle*, XXVI. 8. Par. 1820.)

(T. Y.)

MALWAH, an extensive province of Hindostan, situated principally between the 22d and 23d degrees of northern latitude. On the north it is bounded by the provinces of Ajmeer and Agra, on the east by Allahabad and Gundwaneh, on the south by Khandeish and Berar, and on the west by Ajmeer and Gujerat, being in length about 250 miles, and in breadth 150. Till very recently, the whole of this territory was in the occupation of the Mahrattas, the capitals of Dowlet Row Sindea and Holkar being both in it, and within 30 miles of each other. Malwah is a very elevated region, as numerous rivers have their sources in it, and descend in every direction. The principal of these are the Narbudda, Chumbul, Sopra, and Cane. The land is, however, extremely fertile, the soil being in general a fine black mould, which produces cotton, opium, sugar, indigo, tobacco, and all the various grains of India, besides furnishing pasture for numerous herds of cattle, flocks of sheep, &c. Like Bengal and some other provinces, it has two harvests, the first or superior ending in April, the second or inferior in October. The tobacco, particularly that of the district of Bilsah, is highly esteemed, and carried to all parts of the country. The other articles of its produce are sent to Gujerat, Broach, or into the eastern provinces, by the rivers which communicate with the Jumna. Bickermajeet, one of the most celebrated rajahs of Hindostan, of whom there is any authentic history, reigned over Malwah; he overran many of the other provinces, and compelled their princes to pay him tribute, and acknowledge him as their lord paramount. Such was his fame, that the Hindoos have adopted his reign as one of their eras. It commenced 57 years before the birth of Christ. His capital was situated about a mile to the northward of Oujain, and bore the same name. This province was conquered by the Mahometans in the middle of the thirteenth century; but on the death of the emperor Balin, in 1286, the governor Dilavur Khan rebelled, and laid the foundation of an independent kingdom, which lasted upwards of 170 years. Their capital was Mundu, a very extensive city, situated in the hills, 20 miles south of Oujain. Malwah was subdued, and its capital taken by the Mogul emperor Homayon, in the year 1534, and remained annexed to the empire of Delhi till after the death of Aurungzebe in 1707, when it was invaded, and by degrees taken possession of by the Mahrattas; by whom it was divided into several portions among the chiefs, according to the gradual progress of their arms, which has caused such an intermixture of their territories, that it is extremely difficult to discriminate them. The ancient landholders, called Grassiah, still retain possession of some of the hill forts, and exact contributions from the adjoining districts; and a portion of the southern part of the province was till lately held by the Pindaree chiefs, whose incursions into the British dominions brought on the late Mahratta war.—*Edinburgh Gazetteer, or Geographical Dictionary.*

MARMONTEL (JEAN FRANÇOIS), a celebrated French writer, was born in 1723 at the picturesque village of Bort, in the Limousin, in a family little removed above the rank of peasantry. Like many other distinguished literary men of France, he owed the early part of his education to private charity and gratuitous public institutions. His parents destined him for trade; but his love for study induced him to assume the clerical habit, and to obtain admittance into the Academy of the Jesuits at Clermont. While there he procured a subsistence, by acting, during his leisure hours, as a private tutor to some of the more opulent students. He then went to Toulouse, where he delivered lectures in philosophy with considerable reputation, and gained an academical prize. His disappointment as to another prize opened for him a correspondence with Voltaire, which finally led to his departure from Toulouse for Paris, where he obtained the personal acquaintance of his illustrious correspondent, who at that time extended the most friendly encouragement to all young men possessed of any talents for poetry.

At the time of Marmontel's arrival in the capital, in 1745, the prizes proposed by the Academy opened up one of the shortest roads to literary distinction, and one eagerly pursued by those who were ambitious of celebrity. Marmontel, like many others,

Marmontel. commenced his career of letters by gaining a prize for a poem on a subject proposed by the French Academy—The glory of Louis XIV. perpetuated in his successor. But in that age the theatre afforded the most ample field for the acquisition of wealth and eminence. All talent was in a manner forced into that direction, and was often recompensed with extravagant liberality. In order to qualify himself for dramatic composition, he commenced an assiduous study of the best critical works on the subject, which he borrowed from Voltaire; he obtained free admission to the French theatre, which he regularly attended; and he frequented the *Procope* Coffee-house, which was then the tribunal of criticism, and the school for young poets to study the humour and taste of the public. His first tragedies, *Dionysius* and *Aristomenes*, obtained a reception sufficiently flattering for a youthful poet; but they did not keep their ground on the stage, and his succeeding ones, *Cleopatra*, the *Heraclides*, and *Numitor*, had no success whatever. La Harpe, who was a great dramatic critic, condemns them all as bad, except the *Heraclides*, which he calls a tolerable tragedy of the second rank. In fact, Marmontel does not appear to have been endowed with any talents for poetry, at least of the higher order, either in point of poetical conception or the mechanical construction of verse. It is also evident, from his *Reflexions sur la Tragedie*, published at the end of his *Aristomenes*, that he had formed, at least in the early period of his life, the most unfounded and paradoxical theories with regard to the rules of dramatic composition. Hence his plots have, for the most part, but little interest; his dialogue is full of puerile common-places; and his versification is cold and constrained. The plot of *Dionysius* hinges on the conspiracy of Dion against the Sicilian tyrant, and the love of the younger Dionysius (who, in defiance of all historical truth, is represented as a paragon of virtue) for the daughter of Dion, whose character is formed on the model of the heroines of Calprenede and Scuderi. The plots of *Aristomenes* and *Numitor* are, for the most part, of his own invention, and are both sufficiently extravagant. In the *Heraclides* he has followed the well-known tragedy of *Euripides* as his guide. At his first interview with Voltaire, Marmontel had been assured by him, that by the stage he might in one day obtain glory and fortune, and that one successful piece would render him at the same moment rich and celebrated. The prediction was verified; and from the instant at which his first tragedy appeared, he, who had not money to pay the person who brought water to his lodgings, and who lived on credit with his baker and green-grocer, was at once plunged into all the bustling intrigue of the first literary circles, and into all the glare and dissipation of fashionable society. His time was occupied with rehearsals and parties of pleasure; he was received as the favoured lover of the most celebrated actress of the age, Mademoiselle Clairon; and in another intrigue in which he engaged he became the rival of Marshal Saxe. In order to shun the resentment of so formidable a rival, he retired for some time to Passy, the country seat of the rich and sumptuous financier, Popliniere, who had married his mistress, and kept open house for all the idle and dissipated *literateurs* of the age. By flattering the king in some occasional verses, which he wrote while residing here, he obtained the powerful patronage of Mad. de Pompadour, who procured for him the situation of Under Secretary of the Royal Buildings. This employment fixed his residence at Versailles for five years, which were passed wholly free from inquietude, and are often alluded to by him as the happiest period of his life. The duties of his situation occupied him two days in the week, and the remainder of his time was employed in contributing articles to the *Encyclopédie*, of which his friends D'Alembert and Diderot were the Editors. These articles, which contain many ingenious theories, mixed with strange paradoxes, were afterwards printed together, in alphabetical order, under the general title of *Elements de Litterature.* * Marmontel.

Having been engaged about the same time in writing on the subject of comedy, and searching into nature for the rules and means of the art, this study led him to examine if it were true, as was then often said, that all the great strokes of ridicule had been seized by Moliere and the dramatic poets who followed him. In running over the canvass of society, he perceived that, in the inexhaustible combinations of follies and extravagancies of all conditions of life, a man of genius might still find sufficient employment. He had even collected some observations to propose to young poets, when his friend M. de Boissi, who at the time conducted the *Mercure de France*, requested him to supply some pieces in prose, to insert in that literary Journal, from which Marmontel derived a considerable pension. It occurred to him to employ, in a tale, one of the touches of ridicule in his collection; and he chose, by way of essay, the absurd pretension of being loved merely for one's self. This was exhibited in the first of his *Moral Tales*, entitled *Alcibiade ou Le Moi*. The story was much admired, and was by some attributed to Montesquieu, and by others to Voltaire. Its success induced him to write other tales of a similar description; and thus commenced the *Contes Moraux*, which were subsequently collected and printed by themselves. Many of these tales, on which the fame of Marmontel principally if not solely rests, bear reference to the original idea with which they commenced, being for the most part intended to expose some absurdity or extravagance of character. Thus the second displays the folly of those who exert authority in order to bring a woman to reason; and he chose, for example of this, a sul-

* M. de Chapsal has extracted from the *Elements de Litterature* every thing that related to eloquence, and placed the remarks not in alphabetical order, but in that of the subject. This work, which is intended to form a manual of French rhetoric, is entitled *Principes d'Eloquence de Marmontel extraits de ses Elemens de Litterature et mis en ordre.* Paris, 1809.

tan and his slave, as being placed in the two extremes of power and dependence. In most of them he has reached a very happy imitation of nature, in the manners and language; and it is only to be regretted that he has occasionally thrown a too glittering varnish over conceptions of the most beautiful simplicity. As lively pictures of French manners, both simple and fashionable, they are admitted to be unrivalled. The early part of the life of Marmontel was passed amid scenes of rural innocence, with a family which lodged in a cottage, and subsisted by the labour of their hands; the remainder of his days was spent in the most brilliant and refined society which Paris or the world afforded, exhibiting the most splendid union of literary talents, with all the polish of exalted rank, and the graces of female elegance. This enabled him to succeed in scenes and characters which were extremely remote, and, indeed, contrasted to each other—in the delineation of the innocent pleasures of the country, as well as the rivalships, whims, and levities, of gay or splendid life. *The Shepherdess of the Alps*, which has been the most popular of them all, and *Les deux Infortunées*, are as distinguished for simple and touching pathos as the great proportion are for liveliness. The style is remarkable for facility, and the ease with which it inclines, in pursuing the course of events, to the ludicrous or pathetic.

After the death of M. de Boissi, Marmontel obtained the patent and sole management of the *Mercure*, of which he had long been the chief support. On receiving this appointment, he resigned that which he held at Versailles, and fixed his residence at Paris, in apartments assigned to him in the house of Mad. Geoffrin. He appears to have conducted the Journal of which he had charge with great ability and judgment. Few periodical works have appeared more diversified, more attractive, or more abundant in resources; and many who afterwards came to hold the highest rank in French literature were first introduced through it to the favour of the public. After he had conducted it, however, for two years, he became suspected of writing a satire against some powerful nobleman. He was, in consequence, shut up for a few days in the Bastile, and on his release, was deprived of his agreeable and lucrative situation. But this misfortune did not discourage his literary exertions. Soon after he had recovered his freedom, he translated into prose the *Pharsalia* of Lucan, of which he was a great admirer. He also added to it a supplement, in which he details the events of Cæsar's war in Africa, and concludes with his last campaign in Spain. The French have at all times been great dealers in prose translations of the Classics. But though the shape in which Marmontel exhibited the *Pharsalia* can never convey an adequate idea of the original, his work is more agreeable to read than the turgid poetical version of Brebeuf, by which it was preceded.

About the same time at which he completed the translation of the *Pharsalia*, he published his *Poetique Françoise*, containing observations extracted from the various articles which he had furnished for the *Encyclopédie*. It is divided into two parts, the first expounding the elementary principles of poetry, and the second applying them to its different sorts.

Being about this period seized with a disorder in the chest, which had proved fatal to both his parents, he resolved to devote his remaining days to the composition of a Romance, or fiction of the higher order. The subject he chose was *Belisarius*, suggested to him by a print he possessed from the celebrated picture of Vandyck. The fact on which his tale is founded was rather a popular tradition and opinion than a historical truth. But the belief had so universally prevailed, and the idea of a blind old man reduced to beggary had been so closely associated with the name of Belisarius, that it possessed all the advantages essential for the purposes of historical romance. In other particulars, the author relied on the faith of history, and Procopius chiefly was his guide. On its first appearance, in 1767, *Belisaire* attracted universal attention. The first seven chapters, describing the journey of the old blind hero to the village where his family resided—his arrival there, and the visit paid to him by Justinian, in his humble habitation, are possessed of an interest almost dramatic, and are composed in a higher tone of eloquence than any thing else which he has written. But those which follow are almost entirely destitute of incident, and are just so many separate lectures on different branches of government and politics delivered by Belisarius to Justinian. In the course of these dissertations, there are evidently many references to political incidents, and the system of French politics pursued in the middle of the seventeenth century. The last chapter, on religious toleration, involved the author in a dispute with the Sorbonne, who published a censure on it, which was opposed by the arguments of Turgot, and by the epigrams and squibs of Voltaire.

Though Belisarius cost its author many sleepless nights, he recovered during its composition from the disorder which had excited him to the undertaking, and he sometime after produced his *Incas of Peru*, dedicated to Gustavus King of Sweden. Irritated as he was by the recent anathemas of the Sorbonne, his great object in this new romance was to show, that all the evils inflicted by the Spaniards on the Indians had their origin in that fanaticism which he was desirous to bring into still deeper detestation. In Fernando de Luquez and Vincentio Requelme he has given a sort of personification of fanaticism in its most hideous form, and has contrasted their characters with that of Las Casas, which is intended as a model of the exalted piety and tempered zeal most becoming in a Christian. In the history on which this romance is founded, Las Casas had given a tremendous picture of the atrocities committed by the Spaniards in Peru, and of the sufferings of its inoffensive inhabitants. The pencil of Marmontel had scarcely sufficient strength to paint the determined courage, rapacity, debauchery, and remorseless cruelty of the soldiery let loose on the Indians, nor the desperate characters of the adventurers at their head, who knew no law but the sword, and whose sole object was plunder. In painting Indian scenes of innocence, tranquillity, and peace, he has been more

Marmontel. fortunate. But he has unluckily abandoned the simplicity, which charmed so much in his *Moral Tales*, for a tone too highly rhetorical; and there is a want of unity of interest from the multiplicity of episodes. The longest is that of the Conquest of Mexico, related to the Inca by some refugees from that country, and who had come all the way to Quito, apparently for no other purpose than to tell their long story.

In 1763, Marmontel had been admitted, though after considerable opposition, to the much envied place of a member of the French Academy, and, in 1783, he succeeded D'Alembert as its perpetual secretary. The situation of Historiographer of France, and the Chair of History in the Lyceum, which he successively obtained, fully indemnified him for the loss of the *Mercure*. He was in the full enjoyment of affluent circumstances, domestic felicity, and literary reputation, when the French Revolution suddenly changed the scene. During its alarming progress he led a retired life, and though reduced to indigent circumstances, remained secure amid all the violent events of the period. In 1797, he was chosen a deputy to the National Assembly by the department of Eure, but died soon afterwards, of an apoplectic attack, at his cottage near Abbeville.

Several of his pieces were published after his death. The *Nouveaux Contes Moraux*, which were inserted in the *Mercure*, had been extracted from that journal, and translated into English soon after their first appearance: but they were not printed apart in their original language till after the demise of the author. This second series is inferior in delicacy, grace, and beauty of style, to the former; but the scope and tendency of the stories is more strictly moral. On account of his situation as Historiographer of France, Marmontel had thought it a duty incumbent on him to write some historical work. The period he chose was the Regency of the Duke of Orleans, which he commenced in 1784; but though he completed it four years afterwards, it was not given to the public during his life. This work is not such, either in point of accuracy of facts, or enlightened general views, as might have been expected from the time occupied in its composition, the materials which his situation opened up to him, or the pompous account which he himself gives of his access to information: "All the great men," says he, "of the age opened to me the repositories which contained documents on my subject. The Count de Broglio initiated me into the mysteries of his most secret negotiations, and Contades traced to me, with his own hand, the plan of his campaigns, and particularly of the battle of Minden." The most interesting part is the last chapter, containing the relation of some particular incidents which occurred during the regency, as the plague at Marseilles, and the visit of the Czar Peter to France.

The *Posthumous Memoirs* of Marmontel, drawn up in his declining years for the instruction of his children, and edited in 1804, from a MS. in his own hand-writing, are among the most amusing volumes of the description ever presented to the public. They commence with the author's earliest youth: the portion which comprehends this period of his life is written in the happiest style of his *Moral Tales*, and contains many interesting anecdotes of humble innocence, many animated sketches of domestic happiness, and many agreeable traits of village society. In the succeeding part, the portraits of the most distinguished characters, in the most brilliant age of France, are delineated with so much life, discrimination, and delicacy, and every thing is sketched with a colouring so light and aërial, that the whole representation is exquisite. There is scarcely a single person of note in France whose likeness is not exhibited in this vast gallery,—the pictures of Voltaire, D'Alembert, Marivaux, Thomas, St Lambert, and Helvetius, are all excellent. The society which Marmontel frequented was probably the most refined and brilliant that had ever assembled together; but there was evidently a restraint, a desire of exhibition, and want of ease in its intercourse. "Every guest," says Marmontel, "arrived ready to play his part; in Marivaux, impatience to give proof of acuteness and sagacity was visibly betrayed; Montesquieu, with more calm, waited till the ball came to him, but he expected it; Helvetius, attentive and discreet, sat collecting for a future day." Literary fame was enjoyed in France in its greatest extent, but also in its greatest anxiety. Of all the others, Voltaire had gained the most brilliant literary success; yet of him Marmontel remarks, that his glory was too dearly paid by the tribulations to which it had exposed him. It had been said by Mad. Genlis, that Marmontel, in his *Moral Tales*, showed gross ignorance of the French manners and character, in representing the higher classes, particularly of females, as so voluptuous, and in many cases abandoned; but the *Memoirs*, if they record the truth, unhappily confirm his representations. When so much amusement is derived from his minute descriptions it is perhaps hypercritical to remark, that some petty circumstances, of no general interest, and which might have been better thrown into the back-ground, are brought too much out on the canvass, and are drawn in disproportioned magnitude. But for these details, he states as his apology, that it is for his children he writes the history of his life, and that those things which may appear too minute to strangers, will prove interesting and useful to them. The concluding volume, containing a sketch of the first events of the Revolution, is confused and imperfect. Its incidents were too gigantic for the grasp of his mind, and he appears to have been dizzied and stupified by the rapid whirl and total subversion which he witnessed.

An author by profession, the literary character of Marmontel may be fully appreciated from his various and numerous productions. Though he admits that, while he has given the portrait of others at full length in his *Memoirs*, he has only painted himself in profile; yet from them his private character may be correctly enough estimated. On a review of these, it has been remarked, "That without great passions, or great talents, he seems to have had a lively imagination, a pliant and cheerful disposition, and a delicacy of taste and discrimination, of still greater value in the society which fixed his reputation. Although good tempered and social, he

seems to have been, in a good measure, without heart or affection; or rather the dissipated and sensual life to which he devoted himself after his removal to Paris, appears to have obstructed in him the growth of all generous and exalted feeling. In society he was joyous and easy; gay, without affecting to dazzle; and ingenious, without intolerance or fastidiousness. (M.)

MASKELYNE (NEVIL), a most industrious and accurate astronomer, born in London, 6th October 1732, was the son of Edmund Maskelyne, Esq. a gentleman of respectable family of Purton in Wiltshire.

He was sent at the age of nine to Westminster School, and continued to apply with diligence to the usual pursuits of that place, until the occurrence of the great solar eclipse of 1748, which made a strong impression on his mind, and which was the immediate cause of his directing his attention to astronomy, and of his beginning the study of the mathematics with great ardour, as subservient to that of astronomy. It is remarkable, that the same eclipse is said to have made an astronomer of Lalande, who was only three months older than Maskelyne. He soon after entered as a member of Catherine Hall, Cambridge, but shortly removed to Trinity. He took a degree as Bachelor of Arts with great credit in 1754, and proceeded regularly afterwards through the succeeding stages of academical rank in divinity. He was ordained in 1755 to a curacy at Barnet, and the next year obtained a fellowship at Trinity. In 1758 he was elected a Fellow of the Royal Society, having previously become intimate with Dr Bradley, and having determined to make astronomy the principal pursuit of his life, feeling its perfect compatibility with an enlightened devotion to the duties of his own profession.

In 1761 he was engaged by the Royal Society to undertake a voyage to St Helena, in order to observe the transit of Venus. He remained ten months in the island, but the weather prevented his observing the transit to advantage, and the faulty attachment of the plumb-line of his quadrant, which was of the construction then usually employed, rendered his observations on the stars less conclusive with respect to annual parallax than he had expected. His voyage was, however, of great use to navigation, by promoting the introduction of lunar observations for ascertaining the longitude; and he taught the officers of the ship which conveyed him the proper use of the instruments, and the mode of making the computations.

He performed a second voyage, in 1763, to the island of Barbadoes, in order to determine the rates of Harrison's watches, and to make experiments with Irwin's marine chair, on board of the Princess Louisa, Admiral Tyrrel, acting at the same time as chaplain to the ship. The chair he found of very little use for observing the eclipses of Jupiter's satellites, and the maker of the chronometers was not satisfied with his report of their performance; fancying that he was too partial to the exclusive employment of lunar observations for determining the longitude. The liberality of the British Government, however, bestowed on Harrison the whole reward that he claimed; and Maskelyne, having been appointed to the situation of Astronomer Royal, and having thus become a member of the Board of Longitude, was extremely active in obtaining a few thousand pounds for the family of Professor Mayer, who had computed lunar tables, and a compliment of L.300 only for Euler, whose theorems had been employed in the investigation.

The merits of Mayer's tables having been fully established, the Board of Longitude was induced to promote their application to practical purposes, by the annual publication of the *Nautical Almanack*, which was arranged and conducted entirely under Maskelyne's direction for the remainder of his life. He was also actively employed, without any other motive than the love of science and of his country, in almost every decision which was required of the Board of Longitude; and he had to give his opinion of the merits of an infinite number of fruitless projects which were continually submitted to his judgment. He must of course have made many enemies among the weak and illiberal; but the universal impartiality, and the general accuracy of his determinations, were acknowledged by all candid persons; and it must be admitted that the longitudinary speculators of Great Britain do in general submit to discouraging remarks from persons in authority with wonderful fortitude, and with great personal civility.

During the forty-seven years that he held the situation of Astronomer Royal, he acquired the respect of all Europe by the diligence and accuracy of his observations, which he never neglected to conduct in person whenever it was in his power, and he required only one assistant. The French had a handsome building to amuse the public by its exterior magnificence, but the establishment of the observers was never arranged in so methodical a manner as that of the English National Observatory, and the fruits of their labours were never systematically made public; the attempt which was once made by Lemonnier, in his *Histoire Céleste*, having been interrupted and discontinued. Dr Maskelyne, on the other hand, obtained leave from the British Government to have his observations printed at the public expence, under the direction of the Royal Society, who are the legal visitors of the Observatory, appointed by the King's sign manual. The early observations of Flamsteed and Bradley were considered as private property: Flamsteed published his own, and Bradley's were very liberally bought of his family, and afterwards printed by the University of Oxford, who are still as liberal in bestowing them where they are likely to be employed for the benefit of science. Flamsteed was the Astronomer Royal from 1690 to 1720; then Halley to 1750; Bradley to 1762, and Bliss to 1765, when Maskelyne was appointed. He took his doctor's degree in 1777.

He made several improvements in the arrangement and employment of the instruments, particularly by enlarging the slits through which the light was admitted; by making the eye-glass of his transit telescope moveable to the place of each of the wires of the micrometer; and above all, by marking the time to tenths of a second, which had never been attempted before; but which he found it practicable to effect with surprising accuracy, as the comparison of the

Maskelyne. observations at the different wires sufficiently demonstrated.

The object of his expedition to Shehallien is well known. Bouguer had made an unsuccessful attempt to measure the attraction of a mountain in South America, and had been obliged to conclude that the mountain was hollow, in consequence of the eruption of a volcano, the attraction being too little sensible. Dr Maskelyne's results, on the other hand, as computed by Dr Hutton, made the mountain more dense than could well have been expected; but those who are acquainted with the difficulty of executing astronomical measurements without an error of a single second of space, will be ready to allow that the deviation of 5″ or 6″, attributed to the effect of the mountain, is liable to a much greater proportional uncertainty than the results obtained by Mr Cavendish with the apparatus invented by Mr Michell. (See CAVENDISH.) The geodetical operations which were soon afterwards performed with his concurrence and assistance, for determining the relative situations of Greenwich and Paris, were equally creditable to the English artists who constructed the instruments, and to the astronomers and geographers who made the observations with them; and they excelled, even by the confession of their rivals, every thing that had ever been effected in former measurements of the same kind.

As no man had done more for practical astronomy than Dr Maskelyne, so there was none whose merits were more justly appreciated. He made every astronomer his friend, as well by his personal kindness, as by his professional labours; and he obtained the rare distinction of being made one of the eight foreign associates of the Parisian Academy of Sciences. His example and encouragement contributed to the establishment of several private observatories, which must always be, if not immediately, at least remotely, beneficial to astronomy, as tending to promote the improvement of instruments, and of the methods of employing them.

He was modest, and somewhat timid, in receiving the visits of strangers; but his usual conversation was cheerful, and often playful, with a fondness for point, and for classical allusion. He inherited a good paternal property, and he obtained considerable preferment from his college; he also married, somewhat late in life, the sister and co-heiress of Lady Booth of Northamptonshire. His sister was the wife of Robert Lord Clive, and the mother of the present Earl of Powis. He died the 9th of February 1811, in his 79th year, leaving a widow and an only daughter.

1. Dr Maskelyne's first communication to the Royal Society is *A proposal for discovering the annual parallax of Sirius. Phil. Trans.* LI. 1760. p. 889 It is founded on Lacaille's observations, made at the Cape of Good Hope, which appeared to indicate a maximum amounting to 8″ 2. *A theorem for spherical aberration.* LII. 1761. p. 17. Dated from the Prince Henry, St Helen's Roads; the calculation is adapted to the object-glasses of achromatic telescopes. 3. The next article, p. 21, is a letter from Lacaille, recommending him to make observations at St Helena on the lunar parallax, and to remain some time in the island for that purpose; promising, on his own part, to make corresponding observations. It is followed by a *Letter* from Maskelyne, proposing some *additional joint observations.* 4. *Observation of the transit of* 1761, p. 196. The sun was lower than had been expected, and the instant of contact uncertain, from a tremulous motion in the apparent discs. 5. *Observations on a clock of Shelton,* 1762, p. 434. Giving the proportion of .99754 to 1 for the comparative force of gravity at Greenwich and at St Helena. 6. *A letter on the mode of observing and computing lunar distances,* p. 558. Dated from St Helena: the first demonstration of the practicability and utility of the method. He found the error of observation not to exceed half a degree of longitude, an error which was very strangely suffered to remain as a fair allowance for the uncertainty of observation, in the acts for encouraging the perfection of the lunar tables, only very lately repealed. 7. *On the tides at St Helena,* p. 586. Observations made in a harbour, for about two months. 8. *Note to Lalande,* p. 607. On lunar distances and occultations. 9. *Rules for correcting lunar distances. Phil. Trans.* 1764, p. 263. A demonstration of the rules before published in the *Transactions* and in the *British Mariner's Guide.* 10. *Remarks on the equation of time,* p. 336. Correcting a mistake of Lacaille, and an inadvertence of Lalande, and giving a formula, which, though not geometrically perfect, is abundantly accurate for all practical purposes. 11. *Astronomical observations made at St Helena,* p. 348. The observations for determining the lunar parallax were too few to afford a satisfactory result. The author suggests, that the figure of the earth might be ascertained by repeated and comparative observations of the apparent distance of the moon from neighbouring stars. 12. *Observations made at Barbadoes,* p. 189. Especially on Jupiter's satellites. 13. *Introduction to two papers of Mr Smeaton.* LVIII. 1768, p. 154. The one on the menstrual parallax, the other on observing stars out of the meridian. 14. *Introduction to the observations of Mason and Dixon,* p. 270. 15. *Conclusion respecting the length of a degree,* p. 323, 325. Mr Charles Mason had been sent with Mr Dixon to observe the transit of 1761, at Bencoolen, but their voyage was interrupted by accidental circumstances, and they made their observations at the Cape of Good Hope, with tolerable success. They then proceeded to join Maskelyne at St Helena, and to assist in his operations there. They were afterwards engaged by Lord Baltimore and Mr Penn, to determine the boundaries between Maryland and Pennsylvania; and having completed their survey, they suggested to the Council of the Royal Society the eligibility of measuring a degree in the country bordering on the Delaware and Chesapeake. Their proposals were readily accepted, and the results of their measurement are here recorded. Dr Maskelyne afterwards employed Mason, in his operations on Shehallien, and in computing Bradley's observations, and in improving Mayer's tables, by a comparison with them; but he was so fearful of admitting any empirical corrections, not founded on the most general principles, that he would not allow some of the equations, discovered by Mason, to be intro- Maskelyne

Maskelyne. duced into the computation of the *Nautical Almanac*, until Laplace had proved their dependance on the theory of gravity. Lalande tells us, that Mason was dissatisfied because he did not receive a public reward for the success of his labours; but he was, in fact, little more than the agent of Maskelyne, and of the Board of Longitude; and he was fairly repaid for the time and labour which his computations had required. Delambre says, that he died in Pennsylvania in 1787. Dixon is said to have been born in a coal mine; and to have died at Durham in 1777. 15. *Postscript respecting French and English measures*, p. 325. The result of this comparison agrees admirably well with the later measurement of Pictet, Prony, and Captain Kater. 16. *Observation of the transit of 1769, made at the Royal Observatory*, p. 355. 17. *Eclipses and occultations*, 1769, p. 399, chiefly for the longitude of Glasgow. 18. *On the use of Dolland's micrometer*, 1771, p. 536. On the application of the divided object-glass micrometer to determining differences of right ascension and of declination, especially in the case of transits. A part of the instructions sent with the observers to the South Seas. 19. *On the adjustment of Hadley's quadrant*, 1772, p. 99. Especially for the back observation; and to insure the parallelism of the glasses. 20. *Deluc's rule for measuring heights*, 1774, p. 158. Adapted to English measures, and rendered somewhat more convenient. 21. *Observations at Greenwich and in America compared*, p. 184, 190. 22. *Proposal for measuring the attraction of a hill*, 1775, p. 495. Read in 1772. 23. *Observations made on Shehallien*, p. 500. A paper which obtained its author the honour of a Copleian medal. Mason had been sent to examine the hills of Scotland, and had recommended Shehallien; the funds were supplied by the remainder of the royal grant for observing the transit of Venus. Mr Reuben Burrow and Mr Menzies were principally employed in assisting the Astronomer Royal in his observations and surveys; and Dr Hutton afterwards made the necessary computations for determining the attraction of the mountain. 24. *Description of a prismatic micrometer*, 1777, p. 799. Consisting of one or more prisms sliding in the axis of the telescope; and resembling in its operation that of Rochon, which has in great measure superseded it. 25. *On the longitude of Cork*, 1779, p. 179. Observations for correcting the computed times of the eclipses of Jupiter's satellites. 26. *On the comet expected in* 1789, *Ph. Tr.* 1786, p. 426. Supposing those of 1532 and 1661 to be the same. (See MECHAIN.) 27. *On the latitude and longitude of Greenwich*, 1787, p. 151. With Cassini's memoir on its uncertainty, which he states as amounting to 11″ in longitude, and 15″ in latitude. Dr Maskelyne, however, shows that it is confined within much narrower limits, though he approves of the object of the memoir in promoting a survey. 28. *On a difficulty in the theory of vision*, 1789, p. 256. This paper sufficiently proves, that Euler was mistaken in thinking the eye achromatic; and that any appearance of colour which it could produce, according to the common laws of refraction, would be imperceptible in ordinary circumstances. But that there are circumstances, under which such appearances may be observed, has been more lately shown by Dr Young and Dr Wollaston. 29. *Account of an appearance of light on the dark part of the moon*, 1793, p. 429. Seen by Mr Wilkins, and by a servant of Sir George Booth, and supposed to have arisen from a volcano. 30. *Observations of the comet of* 1793, *Ph. Tr.* 1794, p. 55. Discovered by the Rev. E. Gregory of Langar, in Nottinghamshire.

Maskelyne ‖ Mauritius.

31. The earliest of Maskelyne's separate publications was his *British mariner's guide*, 4. Lond. 1763. A small volume, which has become scarce, having been superseded by later works.

32. *The nautical almanac and astronomical ephemeris* for 1767 appeared in 1766; and the publication has been regularly continued upon the same plan to the present time, by the computers and comparers whom Dr Maskelyne had trained by his instruction and example. His successor in the Observatory, though admirably qualified to equal, and perhaps to excel him in the practical department, had it not in his power to devote so much of his attention to the publication, as Dr Maskelyne's paternal affection for a child of his own had induced him to bestow on it: and the Board of Longitude was very liberally furnished by the present ministry, with the means of obtaining some further assistance to supply his place.

33. *Tables requisite to be used with the nautical almanac*, 8. Lond. 1766, 1783, 1802. Now partly superseded by Professor Lax's new edition.

34. The volume of *Selections*, from the additions that have been occasionally made to the *Nautical almanac*, 8. Lond. 1812, contains several papers of Dr Maskelyne. For example, *Instructions relating to the transit of Venus in* 1769, N. A. 1769. *Elements of lunar tables*, and *Remarks on Hadley's quadrant*, N. A. 1774. *Advertisement of the comet expected in* 1788, N. A. 1791. *On the disappearance of Saturn's ring in* 1780, N. A. 1791.

35. The *Astronomical observations made at Greenwich*, from 1765 to 1811, were published annually in folio; making three volumes, and part of a fourth. Lond. 1774.... They are allowed to constitute the most perfect body of astronomy in detail that was ever presented to the public. The first volume contains a variety of useful tables, accompanying the observations for 1772; and principally serving for the correction of the places of the stars, and for facilitating the solution of other astronomical problems. Many of them have been reprinted in Vince's *Astronomy*; but, in some cases, without the necessary explanations.

[(Kelly in) Rees's *Cyclopædia*. Art. MASKELYNE. Chalmers, *Biographical Dictionary*, XXI. 8. Lond. 1815. Delambre, *Mém. Inst. Sc.* 1811, H. lix.; and in *Biographie Universelle*, XXVII. 8. Par. 1820.]

(N. A.)

MASON (CHARLES), an able astronomer. See MASKELYNE.

MAURITIUS. We have little to add to the account of this island contained in the *Encyclopædia*, except what is derived from the accounts given of it by Captain Flinders, and the official documents from the public offices since it has become a British possession.

The expedition for its conquest was planned in India, and executed with considerable talent and arrangement. The forces were collected from various parts of India in the middle of the year 1810; they rendezvoused at the island of Rodriguez in October of that year, and landed on the eastern side of Mauritius the latter end of December, without any opposition. The capital is strongly defended on the sea side, but towards the land its defences are weak, from their great extension. When the troops were landed they were not opposed on their march by any corps of the enemy, and had only the asperities of a mountainous country to overcome. On reaching the capital, in which all the military strength of the colony was concentrated, and where a respectable defence was expected, preparations were made for storming it, which were rendered needless by a flag of truce being sent. A capitulation followed, and the surrender of the capital, the forts, and the whole island, was executed on the 4th January 1811.

By the peace of Paris, in 1814, the full and perpetual sovereignty of this valuable settlement was ceded to Great Britain, and has continued under the colonial system of his Majesty's other distant possessions, independently of the control of the East India Company.

The extent of this island is about 31 leagues in circumference, being 11 leagues in length, and 7 in breadth. Its surface contains 432,600 British statute acres. The north-west part is level, but the north-east is covered with mountains of various heights, from 2700 to 3150 feet. The scenery in the mountainous parts is highly picturesque, exhibiting lofty rocks, deep ravines, and impetuous cascades. The south-west part is an extended mountain plain, whose mean height above the level of the sea is about 1500 feet, and where a more mild and temperate climate is enjoyed, than in the capital or the other parts on the sea-coast. This elevated plain (Wilhelm's Plain) occupies a considerable portion of the interior of the island, extending from near the sea on its northern extremity, to near Port Bourbon on the south-east coast, and its surface is about 90 square miles. On this plain are several lakes, from which issue the numerous rivers and rivulets that water the island.

One of the lakes, the Mareaux Vacouvas, is one of the natural curiosities of the country. It is an irregular piece of fresh water, about one mile in length, surrounded with many hundred acres of swampy land, through which it receives several streams from the neighbouring hills. It is said to be from 20 to 25 fathoms deep, is well stocked with eels, prawns, and a small red fish called dame-cere, brought originally from China. The eels and prawns are indigenous, and attain a large size; the latter are sometimes found six inches long without the beard, and the eels are commonly from six to twenty pounds weight, and are said occasionally to attain the weight of eighty pounds; they are delicious food, and the larger they are the more highly is their flavour esteemed. Its form has more affinity to the conger than to the fresh water eel, and nearly resembles the species caught in the small streams on Norfolk Island, in the Pacific Ocean. About six miles from Vacouvas lake, another lake, called the Grand Basin, greatly exceeds it in depth. This basin is nearly half a mile in diameter, of a circular form, and said to be more than eighty fathoms in depth. The banks are rocky, and have the appearance of a mound, thrown up to prevent the waters from overflowing, and the surrounding land, especially to the southward, being considerably lower, gives the basin the appearance of a cauldron, about two-thirds filled. No perceptible stream runs into it, but several issue from it through hollow parts of the rocky bank. These, by various additions, form three rivers, that run into the sea on the south and south-east sides of the island. No great difference takes place in the level of the water, except after heavy rains, when the supply, which must come chiefly from the springs in the bottom, so far exceeds the quantity discharged as to raise it sometimes as much as six feet. The elevated bank round this basin consists of stones loosely thrown together, which, though porous, are heavy and hard, of a dark grey colour, and contain numerous specks, which appear to be feld-spath, with some particles of mica and olivine: it is more or less ferruginous, and in some parts appears to run in the manner of lava. It is natural to infer, that, if the whole island does not owe its existence to subterraneous fire, it has been subject to volcanic eruptions, and that the Grand Basin is the remains of one of them.

The climate, on these elevated plains, is remarkably moist. A day seldom passes in the whole year without rain upon them, whilst on the low grounds very little falls, except from December to March. This moisture creates an abundance of vegetation, and would render the middle parts of the island extremely fertile, if the soil were not washed down by the violent rains into the low lands, and into the sea as soon as it is formed. The little soil that does accumulate is good, and increases, though slowly, for the decayed wood adds something to its quantity every year, whilst the trunks and roots of the trees save a part from being washed away. A plantation covered with loose rocks is found to retain its fertility the longest, apparently from the stones preserving the vegetable mould from being washed away. The produce of the different districts in Mauritius varies according to their elevation and climate. The chief food for the black population, consisting of maize, rice, manioc, and sweet potatoes, is raised with great facility in different parts; but owing to the want of roads, and the scarcity of beasts of burden, which renders it necessary to employ human labour in conveying productions to market, the prices vary very much in different parts. The articles cultivated for exportation are by no means profitable, as the planters of the neighbouring island of Bourbon can raise coffee and cotton much cheaper, and of better qualities. The spices of Ceylon have been attempted to be cultivated, but hitherto with little success. There are few indigenous fruits, and none abundant, except the plum which grows on the ebony tree; but the banana, the pine apple, the melon, the jack, the orange, the lemon, the Avogada pear, the mangosteen, and the

Mauritius.

cocoa tree, have been introduced, and propagated with various success. The most valuable of its trees was the ebony, the heart of whose timber is usually sold by weight. It is a slender and lofty tree, having only a few branches near the top. It produces clusters of an oblong fruit the size of a plum, full of a viscous sweetish juice of rather an agreeable taste. The usual circumference of a good tree is from three to four feet; when the exterior wood is chipped away, a black log remains of about six inches in diameter, and from twelve to fifteen feet long, whose weight usually exceeds three hundred pounds. It is principally exported to the China market. At one time, the planters were induced to cut those trees that had not attained a sufficient size, and as its growth is very slow, there is not the same abundance of them as was formerly found on the island.

Mauritius seems more exposed to the visitation of hurricanes than any other spot on the globe. These usually occur between the months of December and May. Their force is irresistible, and in their course they lay flat the productions of the fields, dissipate most of the marks of industry, scatter the houses, and compel the ships in the roads to abandon their anchorage and fly to the open sea for safety. The only town in the island is Port Louis; the rest of the inhabitants live in scattered plantations, and though sometimes six or eight houses may be found contiguous, yet generally the nearest neighbour is a mile distant. The entrance to the harbour of Port Louis is defended by strong forts on the island of Tonneliers on one side, and by Fort Blanc on a peninsula opposite to it. From these points to the city the channel is narrow, and when the buoys are removed, difficult to pass. Near the city the anchorage is good, if care be taken to avoid the numerous wrecks that are at the bottom, with a depth of water varying from six to fourteen fathoms. The entrance to the harbour is nearly a course from north-north-east to south-south-west, by which all the shoals are avoided. The tide rises ordinarily about two feet, but at the equinoxes about three feet. The time of high water, at new and full moon, is noon. The only other harbour, called Grand Port, on the south-east side of the island, is but little frequented. It has no town near it, and though, from the prevalence of south-east winds, it is easy of access, from the same cause it is difficult of departure. The Dutch, when in possession of this island, erected a new town near it, but it is gone to decay, and only the vestiges of the buildings are now visible.

The commerce of the island, either with Europe or India, is by no means extensive. The whole of the necessaries of life are supplied to the great mass of the inhabitants from their own cultivation, and the European articles that are wanted for the higher classes require but small importations. No accurate accounts of the imports and exports are returned to any of the offices of government in Great Britain. We have no accounts of the whole population; and the hearsay reports of travellers differ so much as to merit little confidence. The only authentic document is the return of slaves to the colonial register office for slaves. The latest return is that of 1817, when their numbers were 85,423. The free inhabitants are not supposed to be more than as three to two of the slaves; and the whole number of inhabitants may be about 200,000.

(W. W.)

Mauritius || Mayo.

MAYO, a maritime county in Ireland, having the Atlantic Ocean on the north and west, and the counties of Galway, Roscommon, and Sligo, on the south and east. Castlebar, the principal town, is in north latitude 53° 50′, west longitude 9° 8′. It contains 2339 square miles, or 1,496,960 English acres; and is divided into nine baronies, and 62 parishes. Mayo is situated in the province of Connaught; and the see of Killala, whose bishop resides at the town of that name in this county, is within the archbishopric of Tuam. Situation. Extent.

A large proportion of the surface of Mayo consists of mountains, bogs, and lakes. More than half the county, particularly on the west and north-west, may be described as mountainous; and much of this tract is covered with heath, though the sides of many of the hills are green, and the vallies in some places remarkably fertile. Croagh Patrick is 2661 feet high, and Mount Nephin 2630 feet. On the west coast, which is exceedingly irregular, are Broad Haven, Blacksod Bay, and Newport, or Clew Bay, arms of the sea; and a number of small islands, of which Clare, at the entrance to Newport Bay, is the most considerable; and on the north is the bay of Killala. From Castlebar to the inland boundary on the east and south, the country is in general less rugged, and contains a great number of small towns and villages. There is very little full grown wood in Mayo, and the greater part is without plantations. With the exception of Lord Sligo's grounds, on the south-west, and the demesnes of a few other proprietors, the country is naked, and exposed to every storm. Surface

The principal lakes are Lough Carra, Lough Mask, the Lake of Rahins, and Lough Conn; the latter is about nine Irish miles long, and four broad. The rivers are, the Robe and Black river, the Erriff, the Deel, and the Moy, with several smaller streams. The Moy is navigable for boats of 50 tons a few miles from its mouth. Waters.

Iron-ore, slate, ochre, manganese, sandstone, and pipe and brick clays, are plentiful. Iron works were formerly carried on to some extent, but, as in many other parts of Ireland, have been discontinued, from the want of fuel. Near Westport there is a quarry of slates of a quality equal to any brought from England. Here also are great rocks of the *Petrosilex semilucidus*, similar to that which is used in the English potteries. Minerals.

Mayo is divided into estates worth from L. 7000 to L. 20,000 a year; but their extent, owing to their containing a great proportion of waste land, is still greater than in the ratio of their value. If a qualification of L. 1000 *per annum* were required, two grand juries might be formed in this county. Estates.

Agriculture is in a very backward state. The plough, commonly drawn by four horses abreast, is of the worst description, and the harrows are often furnished with tines of wood, instead of iron. It is Agriculture.

Mayo.

still the practice, in the mountain district, to yoke the horses by the tail. But, in some of the baronies, the plough is seldom or never employed at all, the tillage being performed by the spade, and in others they use the spade in cultivating potatoes, and the plough only for corn. Yet potatoes, oats, and on the sea coast, barley, are sown to a considerable extent, and also flax. Wheat is cultivated only in particular spots, and chiefly by proprietors, a few of whom have also introduced turnips, pease, beans, rape, and cabbage. There is some excellent grazing land for cattle in the barony of Tyrawley, and good sheep pastures in Kilmain. Some graziers hold 3000 Irish acres. The English long-horned cattle, which were imported by the principal proprietors, have greatly improved the native breed.

Farms. The size of farms varies with the nature of the soil and surface, but, though several hundred acres are sometimes let out in one farm, yet, as the farms are commonly held in partnership, the space allotted to each tenant is generally only a few acres. As each of them keeps a horse, it is computed that there is one for every ten or twelve Irish acres. The leases are for different periods, 15 years, 21 years, and one, two, and sometimes three lives, or 31 years.

Town. Dr Macparlan, the author of the *Statistical Survey of Mayo*, enumerates forty-six towns at which fairs are held, but most of them are only small villages. The principal towns are Castlebar, Westport, Ballina, Killala, Clare, Ballinrobe, and Newport. None of them are of such importance as to be represented in Parliament. The assizes are held alternately at Castlebar and Ballinrobe.

Wages and Prices. The habitations of the labourers, or cottiers, are in general very wretched, and shared by them with their cow and pig. The cost of a cabin is from L.3 to L.5. The fuel is almost universally bog-turf. Potatoes, oatmeal, milk, and herrings, are, with few exceptions, their only articles of food, the lower classes seldom tasting meat. They are clothed in their domestic manufactures, frizes, druggets, flannels, and linen; a man's complete suit, including hat, shirt, stockings, and shoes, with a great coat, costs about L.2, 17s. 3d. Irish currency. The subsistence of a family of six is said to be worth from L.1〔illegible〕 to L.20. The common price of labour, in 1802, was 8d. a-day; potatoes, 1s. 1d. *per* cwt.; beef, 3d. and mutton 3½d. *per* pound. In 1811, according to Mr Wakefield's information, the wages of common labour were L.12 for the half-year; and, in hay and corn harvest, 1s. 8d. *per* day: the price of potatoes 3d. *per* stone; beef and mutton, 7d. *per* pound; oatmeal, 12s. 6d. *per* cwt.; milk, 2d. and butter-milk, 1d. *per* quart. The English language, according to Dr Macparlan, is general, though, in the mountain barony of Erris, many are entirely ignorant of it; but Mr Wakefield found the Irish universally spoken.

Fisheries. Killala, in some seasons, employs fifty boats in the herring-fishery. At Killery Bay, on the south-west, and Ballina, on the north-east, there are considerable salmon-fisheries, and smaller ones at Newport, and other places.

Manufactures. The linen manufacture is the only one that affords a surplus beyond the wants of the population; but, though it is general throughout the county, it is not conducted on a great scale by individuals. At Castlebar there is a linen-hall. The other articles are coarse woollens for home consumption. At Newport a number of girls are employed in making straw bonnets.

Mayo || Meath.

Representation and Population. The county of Mayo sends two members to Parliament; the Marquis of Sligo and Lord Viscount Dillon have the greatest influence. On the estate of the latter alone there are 2100 registered freeholders. The number of inhabitants, in 1790, is stated by Dr Beaufort at 140,000. The great majority are Catholics; throughout some districts, of fifty miles in extent, there is not one Protestant church.

See Dr Macparlan's *Statistical Survey of Mayo*, and the works quoted under the former Irish counties. (A.)

Situation and Extent. MEATH, a county in Ireland, in the province of Leinster. Its boundaries are Louth, with a small portion of Monaghan and Cavan on the north; the Irish Sea and the county of Dublin on the east, Kildare on the south; and West Meath and Longford on the west. From east to west it extends about 44 English miles, from north to south 37, and contains 965 English square miles, or 617,600 English acres, of which only about a twelfth part consists of bogs and wastes. This county, which gives the name to its diocese, is situated in the ecclesiastical province of Armagh; its divisions being twelve baronies, and 147 parishes. The river Boyne, which intersects it in a north-eastern direction, forms a line of separation between its northern and southern parts, the former being called the Kells, and the latter Dunshaughlin. Having but a few miles of sea coast to the south of the Boyne, and no other rivers of any size, it has no harbours of its own, but easy access to Drogheda, the greatest corn-market in Ireland, situated on the Boyne, in the contiguous county of Louth.

Surface. Meath is, in general, a low, flat, rich tract of country, with a soil of clay or strong loam, incumbent upon limestone or gravel, not remarkable for natural scenery, and having little wood, but containing a few splendid mansions, extensive plantations, and the remains of many religious and military buildings. In its climate it differs little from that of the adjacent counties of Dublin and Louth already described.

River. The principal river is the Boyne, which enters this county from Kildare on the south-west, and passing by the town of Trim, northward to Navan, meets there the Blackwater from the county of Cavan, and from thence flowing westward by Slane and Drogheda, falls into the sea a little below the latter town. It is navigable for small craft to Navan, and for vessels of considerable size to Drogheda. The other streams are inconsiderable, such as the Athboy and Mannoch, which fall into the Boyne, and the Nanny water, which discharges itself directly into the sea.

Minerals. Meath does not, as far as known, abound in minerals. Copper is wrought at Walterstown, south-west of the Boyne. A coarse pottery has been carried on near Knock, in the barony of Morgallion; and in the barony of Navan, on the lands of Ardbraccan, is what is called the "White-quarry," which furnishes a limestone of a beautiful whitish colour, but which

Meath. becomes almost black by exposure to the atmosphere; it is supposed to have been worked for several centuries.

Estate. The landed property of Meath is divided into large estates, a great many of which yield an income of upwards of L.2000 a-year. These are for the most part let out on leases of 21 years and a life; but on some of them there are leases in perpetuity, which have now become more valuable than the freehold property. In 1818, the rent was from L.2 to L.3 the Irish acre.

Grazing is or was, till very lately, a more important object in this county than tillage. Many persons fattened from 300 to 500 cows in a season, besides bullocks and sheep. These they purchase at the beginning of the grass season, and dispose of during the summer and autumn as they are ready, instead of keeping a regular stock all the year. The pastures are considered too valuable to be applied to the rearing of stock. Dairying is not carried to any extent, and the butter made here is said to be held in little estimation. In some instances, where farms are let out for the dairy, the landlord supplies a succession of cows in milk, horses, and land, and the tenant furnishes labour, utensils, &c. paying at the rate of from L.6 to L.7, 10s. *per annum* for each cow. The English long-horned cattle were introduced many years ago into this district, which now contains some of the best specimens of the breed. The sheep are brought from other counties, and, like the cattle, the same stock is kept only for a season.

Tillage. Tillage farms are larger here than in most parts of Ireland; but, according to Mr Curwen, who visited Meath in 1818, the system of management is little better than on the small farms of other districts. The houses and fences are for the most part of the worst description, especially the cabins of the farm labourers, which are miserable mud-walled hovels, sunk below the level of the ground adjoining, and occupied by cows and pigs, in common with the family. The principal food of this class is potatoes with churn-milk, and occasionally oat-meal, butcher-meat being rarely used even among the farmers; and, to add to their privations, fuel is very scarce in different parts of the county. An uninterrupted succession of oats and other corn crops for several years is common; in a few instances even for twenty years. "The common rotation," says Mr Curwen, "is wheat, oats, fallow, potatoes, clover, all without the application of manure." It is customary to work horses intermixed with oxen, of which six are generally yoked together, three pair deep, to a very ill-constructed plough; yet, notwithstanding this management, the wheat crops are in some parts excellent.

Manufactures. Manufactures do not afford employment to any considerable part of the population, though here, as in most parts of Ireland, that of linen is carried on to some extent; and also the weaving of cotton. On the Blackwater and the Boyne there are several extensive flour mills, at which much of the wheat grown in the county is made into flour before being sent out of it. The towns and villages are Trim, where the county assizes are held, Kells, Duleek, Ratoath, Athboy, Slane, Navan, which has a communication by water with Drogheda, Newcastle, Dunshaughlin, Moynally, and Clonard: none of these return members to the Parliament of the United Kingdom. Of the two members for the county, the Catholic interest, according to Mr Wakefield, is powerful enough to return one. The same author estimates that the Catholics are to the Protestants as 40 to 1, which, from other parts of his work, seems to be much too large a proportion for the former. The leasehold, and much of the personal property, belongs to Catholics. According to Dr Beaufort, the population, about 1790, was 112,400, and it is known to have increased considerably since.

See the *Works* of Beaufort, Newenham, and Wakefield, as quoted under the former Irish counties; Thomson's *Survey of Meath; The Parochial Survey of Ireland;* Curwen's *Observations on the State of Ireland*, 1818; and, for antiquities, the article MEATH in the *Encyclopædia*. (A.)

Meath || Mechain.

MECHAIN (PETER FRANCIS ANDREW), a well known practical astronomer and geographer, was born at Laon, 16th April 1744.

His father was an architect, and educated him with the intention of making him his successor in his business. He was afterwards obliged to take charge of two young men at Sens, as their private tutor; and he accidentally became acquainted with Lalande on occasion of the sale of a fine instrument which he had procured, and of which Lalande became the purchaser; and it was under Lalande's patronage that he was brought forward as an observer, surveyer, and computer. He made two voyages with Mr de la Bretonniere, and assisted him in surveying some parts of the coast of France. He was afterwards employed in various computations by the Marquis de Chabert and the Duc d'Ayen.

Having obtained a prize from the Academy of Sciences in 1782, for a *Memoir on comets*, he became a member of the Academy the same year. Having proved that the hopes entertained by some astronomers of recovering an old comet were unfounded, he made up in some measure for the disappointment, by finding them eleven new ones in the course of eighteen years: and he computed the orbits not only of all these, but of thirteen others, which had been discovered by other observers: emulating in this department the labours of both his predecessors, Messier and Pingré.

About 1785, he undertook the publication of the *Connaissance des Tems*, and continued it till he was employed in geodetical operations at a distance from Paris. He was appointed, together with Cassini, de Thury, and Legendre, to make a committee to meet the English astronomers for the determination of the relative situation of the observatories, which had been proposed by Cassini. It was in these operations that he first brought Borda's circle into general use. He was soon after, in 1789, made a Foreign Member of the Royal Society of London.

In 1791, he was appointed, in conjunction with Delambre, to execute the intentions of the Constituent Assembly, with regard to the determination of a basis of linear measures. A variety of delays and difficulties occurred in these operations; in Spain he was wounded in the head and in the side, by an ac-

Mechain. cident which occurred while he was inspecting a water-wheel; and the political circumstances of the times produced many embarrassments, which caused him to linger in Italy perhaps a little longer than was actually necessary; but the establishment of the *Bureau des Longitudes*, and his nomination as a member of it, determined his immediate return to Paris. He was now director of the Observatory, and he entered with great zeal on a series of observations, which were to rival those of Flamsteed, of Bradley, or of Maskelyne; but he seems to have been a little tired of the confinement, and he readily accepted, or rather solicited, the appointment to take a part in the measurements required for the still further extension of the arc of the meridian to the south of Barcelona. But the secret motive for his seeking this humbler employment appears to have been a desire to remove some doubts which he entertained respecting the latitude of Barcelona, as it appeared after his death from his papers, that there had been a discordance of 3″ in some observations which he had not made public In this unfortunate undertaking, he paid a heavy penalty for any want of candour which may have been attributed to the concealment; shipwreck and disease awaited him; and he died at last, at his post, the 20th September 1805, of a fever, which fatigue and a bad climate had brought on. The severe stage of his illness was so short, that his son, who accompanied and assisted him in the survey, had not time to join him.

From the time of his accident in Spain he had become habitually melancholy and timid, though regardless of personal danger in the pursuit of his professional objects. His whole time was occupied in observing and calculating: he published little; and never hazarded to advance any reflections on the subjects which employed him, being probably more in the habit of acting than of speculating. He married, in 1777, Miss Thérèse Marjon, with whom he had become acquainted at Versailles. This connexion was in every respect happy; he was indebted to it for a competent fortune, and he left a daughter and two sons.

1. Of his publications we find the most important in the *Mémoires des Savans étrangers*; that is, besides some *Observations of eclipses and occultations*, a *Memoir on the comets of* 1532 *and* 1661; showing that they are not the same; and their non-appearance seven or eight years afterwards fully justified his conclusions, and the adjudication of the prize.

2. In the *Memoirs of the Academy*, from 1782 to 1784, there are several of his *Observations of transits, eclipses, occultations, and comets*.

3. There are also some letters of Méchain in Zach's *Geographical ephemerides* about 1800, on the instruments of the *Parisian Observatory*, and on other subjects.

4. He edited the *Connaissance des tems*, from 1786 to 1794. See LALANDE.

5. *Base du système métrique*, décimal. 3 v. 4. Paris, 1806, 1807, 1810. The joint work of Méchain and his respectable and indefatigable friend and colleague Delambre.

[Delambre, *Mém. Instit. Sc.* VI. 1806, p. i.; and in *Biographie Universelle*, XXVIII. 8. Paris, 1821.] (M. E.)

Merionethshire.

MERIONETHSHIRE, a maritime county of North Wales. It is bounded on the north by Carnarvonshire and Denbighshire, on the east by the latter county and Montgomeryshire, on the south by Cardiganshire, and on the west by the Irish Channel. It is of a triangular shape, contracting towards the south. Its length from north to south is 36, and its greatest breadth 34 miles. Its area is estimated at 691 miles. Boundaries and Extent

There are few parts of the British Islands on which the scenery is more varied, the surface more irregular, or the prospects more romantic. Many of the peaks of the lofty mountains are near to each other, with deep valleys, or rather chasms between, and in other parts, the variety of objects forming striking contrasts with the vicinity of the sea, give a most picturesque collection of pleasing, though sometimes terrific views. The principal mountains, and their heights above the level of the sea, are Cader Idris, 2914 feet, Arran Fowdy, 2955 feet, Arrening, 2809 feet, Cader Ferwyn, 2563 feet, and Pengarn, 1510 feet. These mountains consist principally of granite, porphyry, and other unstratified rocks, while the secondary hills are composed of different kinds of schistus. Face of the Country.

The principal rivers are the Dee, which runs through this county, and after passing the beautiful town of Corwin, enters Denbighshire; the Maw or Mawddach, which rises in the middle of the county, and empties itself into the Irish Channel; the Dovey, which rises near a pass in the mountains leading to Montgomeryshire, and forming at last a large estuary, enters the sea at Aberdovey; and the Gleslyn and Dwyrid, whose streams unite before entering the ocean. These rivers receive the waters of numerous brooks and rivulets which trickle from the mountains, and in their course fertilise the valleys through which they run. There are several lakes, of which, the most considerable for extent, as well as for beauty, is Llyn Tegid, near Bala, sometimes called Pimblemere. It is about four miles in length, and three quarters of a mile in breadth. Its banks are most beautifully adorned with slopes, partly covered with woods, and partly exhibiting verdant pastures. Lynn Talyllin, at the foot of Cader Idris, is less extensive, but scarcely less beautiful. Some fine cataracts add their beauty to the other romantic scenery of this county; of these Rhaidr Ddu and the fall of the Glyn near Port Llyn Dyffws are the most remarkable; but several smaller ones will well reward the labour of the traveller who delights in the picturesque. Rivers, Lakes, and Cataracts.

The agriculture of the county is in a very imperfect state, though the spirited exertions of some large proprietors have recently exhibited specimens of great improvement. Nearly three-fourths of the county is uninclosed, and much of that part is unproductive waste. Large portions of the marsh lands on the coast have, by inclosing, embanking, and draining, been converted into rich pasture, and much more requires only the application of capital to Agriculture

Merionethshire and Messier.

bring it into the same state. Very little of the land is adapted to the plough, and the principal pursuit of the farmers is breeding and rearing cattle. The heifers from this county are sent in droves to the fairs in the south of England, and when improved by good pasture, are found very valuable beasts. The sheep are of small size, the flesh of which is highly prized, and their wool forms the material for the domestic manufactures.

Trade and Manufac-

There are scarcely any manufactories that can be noticed, except a few coarse woollens; the females of all the families, however, employ themselves in knitting hosiery goods from the native wool. These furnish considerable quantities of the caps called Welsh wigs; and gloves, and stockings, the only goods that are sent out of the county, and the annual value of which is estimated at L.25,000. The only trade is from the harbour of Barmouth, situated on a small arm of the sea, into which several rivulets empty themselves. The port is difficult of entrance, and but little frequented. It is chiefly devoted to coasting trade; exporting oats, barley, butter, cheese, oak-bark, and timber, and importing coals, culm, and groceries. On account of the excellence of the beach, and the romantic beauties of the surrounding country, it has been much frequented of late years for sea-bathing.

-ulation.

By the census of 1811, the population amounted to 30,924 persons, of whom 14,308 were males, and 16,616 females. It has increased less between the enumeration of 1801 and that of 1811 than any other county of England or Wales. The only town is Dolgellen, where the assizes are held, which contained 3064 inhabitants.

The most remarkable seats are those of Sir Robert Williams Vaughan, at Nannau; of Mr Oakley, at Tany Bwlch Hall; Sir Thomas Mostyns, at Cors y Gedel, and Mr Corbet, at Ynysymaengwyn. It returns to Parliament one member for the county.

See Evans' *North Wales;* Davies' *Agriculture of North Wales;* and Aiken's *Tour in Wales.* (W. W.)

MESSIER (CHARLES), a celebrated astronomer, born at Badonviller, in Lorraine, 26th June 1730.

He was the tenth of twelve children, and lost his father when he was 11 years old. He came to Paris at 20, and had then to seek his fortune, having only learned to write a good hand, and to draw. Delisle employed him as a copyist in the observatory. Libour, his secretary, taught him to make use of the common instruments of astronomy, to observe eclipses, and to look out for comets; and this was the principal business of his subsequent life; for he was never much of a theoretical or philosophical astronomer. Delisle obtained for him an appointment as clerk in the Hydrographical Department of the Navy, and gave him his board and lodging in his own house: and he claimed in return the singular gratification of keeping all Messier's observations of comets secret for his own private amusement, until their novelty was completely lost.

Messier had already discovered 12 comets when he lost his wife; his attendance on her sick-bed prevented his discovering a 13th: and it is said that the circumstance added not a litttle to his grief for her loss. He afterwards became Astronomer to the Navy, instead of being only a clerk in the department. He obtained a seat in the Academy with some difficulty, and not till 1770; being considered as too mechanical an observer to have a very strong claim to that distinction. He was fond of drawing charts of the paths of comets, and of other astronomical phenomena; one of these procured him the honour of being made an Academician of Berlin, and another, with Laharpe's interest, obtained him the same distinction from Petersburgh. He was also made a Fellow of the Royal Society of London, in 1764. The highest compliment that he ever received was paid him, perhaps without sufficient reason, by Lalande, who inserted, in his celestial globe of 1775, a constellation with the name of Messier, or *Messium custos,* The Harvest Man; in the neighbourhood of Cepheus. When Herschel had discovered the Georgian planet, he was very diligently engaged in observing its motions; but, in the mean time, his studies were interrupted by an unfortunate accident: he fell into an ice-house, in a garden, which he mistook for a part of a grotto, and fractured an arm and a thigh. He was long in recovering, and he obtained a small pension on the occasion, from the royal bounty, by the solicitations of Mr Sage and some others of his friends, who had interest. He was, however, soon deprived of it by the Revolution; but he continued his pursuits as a private individual, and he amused the last days of the President de Saron by communicating to him his observations, which Saron continued to compute during the imprisonment that was terminated by his barbarous execution. Messier was in some measure compensated for his pecuniary losses by being made a Member of the Institute, of the Bureau des Longitudes, and of the Legion of Honour. He lived, without disease or material infirmity, to the age of 82, when his sight began to fail him, and he required a deep glass, which he found it fatiguing to use. He had afterwards a paralytic attack; but he lived to be near 87, and died of a dropsy, or probably rather of old age, the 11th of April 1817.

1. A variety of his observations, especially of *Comets,* are published in the *Mémoires des Savans étrangeres,* V. VI.

2. After his admission into the Academy, he was a constant contributor to its *Memoirs* from 1771 to 1790. His papers consist almost entirely of *Observations of comets and eclipses,* with some *Accounts of Aurorae Boreales.* There is also a *Catalogue of Nebulae* in 1771; *An Account of points of light seen on Saturn's ring* in 1774; and of *An apparent fall of globules over the sun's disc,* 1777.

3. In the *Connaissance des tems,* there is a collection of his *Observations of the eclipses of Jupiter's satellites.* He had an excellent sight, and excellent telescopes; and he made the duration of the eclipses almost always shorter than other astronomers.

4. He contributed some articles to the *Astronomical Ephemerides* of Professor Hell, published at Vienna.

5. The *Voyage de Courtanvaux sur la fregatte l'Aurore,* 4. Paris, 1768, was written by Pingré;

Messier || Meteorology.

the observations are Messier's: the purpose of the voyage was to make trial of several astronomical instruments.

6. His only separate publication was entitled *Grande comète qui a paru à la naissance de Napoleon le Grand*, 4. Paris, 1808. It was probably not calculated for immortality, even if it was a genuine work of Messier.

7. Delambre is in possession of a number of his *unpublished* observations of the solar spots; but he found their results, when computed, somewhat unsatisfactory.

[Delambre in *Biographie Universelle*, XXVIII. 8. Paris, 1821. See also *Eloge de Delisle*, by Lalande, in *Necrologe des hommes célèbres de France*. 12. Paris, 1770.] (X. A.)

METEOROLOGY,

FROM μετεωρος, *sublimis*, is that science which describes and explains the various phenomena which occur in the region of our atmosphere. It has deeply engaged the attention of men in every state of society, from the roving savage to the refined votary of wealth and pleasure. The moment we cross our doors, we commit ourselves to the influence of the weather. But the hardier classes of the community, the shepherd, the ploughman, and the mariner, whose labour creates or procures the staple articles of life, are always exposed, by their occupation, to the mercy of the elements. They were hence led, by the strongest motives, to examine closely the varying appearance of the sky, and to distinguish certain minute alterations which commonly precede the more important changes. No doubt they would often mistake the indications of those aspects, and would infer conclusions from mere casual circumstances. Those tokens which portend the more violent convulsions of the atmosphere—the pelting storm, or the careering tempest—are generally of a decided character; but the symptoms which go before the ordinary fluctuations of the weather can only be dimly conjectured by long experience and sagacious observation. This shadowy knowledge, this dubious and very limited anticipation of the changes which arrive in the medium we breathe, is merely the fruit of personal assiduity and application. Like the conclusions which men of discernment form to themselves on the subject of physiognomy, it is scarcely communicable; it receives, therefore, no accessions in the progress of ages, but perishes with the individual.

Origin of the Science.

The vague rules which experience had formed on the subject of atmospheric changes were adopted by the philosophers of antiquity, and incorporated into their cosmological systems. But in attempting to explain the phenomena, they sought merely to satisfy the imagination; and the supposition of certain elements, each endued with peculiar properties, appeared, on a superficial view, to connect harmoniously the general facts.

In the infancy of science, however, it was very difficult to distinguish between such appearances as are only incidental, and those constant presages which invariably anticipate their effects. The different fluctuations that happen in the lower atmosphere seemed dependant on the influence of the heavenly bodies, which are continually altering their places. Not only the sun and moon appeared to rule the seasons, but the planets, and even the fixed stars, were conceived to retard or accelerate, by their feebler action, the revolution of the grand cycle of changes. The application of the term *aspect* to the positions of those remote bodies implied a principle of intelligence, and the *stellar influence* shed by them might, therefore, be deemed capable of producing all the variety of effects. Hence the origin of *Physical Astrology*, which has, during so many ages, maintained ascendancy in the world, and still colours the verses of our poets, and pervades the creed of the vulgar.

Influence of Light

The heat evolved by the luminous particles transmitted from the sun, as they lose themselves among the lower strata of our atmosphere, or under the surface of the land and the sea, varying in its intensity, according to the obliquity of their incidence, and the extent of medium which they traverse, produces the most important effects in the great economy of the globe. But the correct knowledge we have at length acquired concerning the mutual action of bodies, contracts the limits of the supposed celestial influence almost to a point. The light of the moon does not amount to the 100,000th part of that of the sun, and the heat which this very feeble illumination excites or communicates, has never been detected by the most delicate instruments, or the best devised experiments. But all the rays shot from the planets, and from the whole constellations of fixed stars, are quite lost in the contrast with those lunar beams. Their combined impressions, during the lapse of countless ages on the atmospheric temperature, would hence elude the utmost powers of calculation.

Tides of the Atmosphere

It is only by their attractive force that the heavenly bodies, except the warming energy of the sun, can ever affect the constitution of this globe. As by their action unequally exerted over its surface, they raise tides in the ocean, so they must likewise agitate the atmosphere with a corresponding reciprocation. This effect, however, depends much more on the proximity of the disturbing body, than on its magnitude or density. Thus the sun, with twenty-three million times the mass of the moon, yet being about four hundred times more distant, has only about the third part of her influence in causing the tides. But, according to the computations of Laplace, the joint action of the sun and moon is only capable of producing a tropical wind, flowing westward at the rate of about four miles a-day; a quantity too small evidently to be ever subjected to observation, and certainly insufficient to occasion any immediate and practical results.

It may be calculated, that Jupiter and Venus, in

Meteorology.

those parts of their orbits which approach the nearest to the earth, affect the aërial tides by a force 76,000 and 82,000 times less than the sun. Those planets could, therefore, excite a most minute shifting in the atmosphere, limited to a foot in the space of 14 or 15 days or about a single mile in 20 years. As the mass of Mars is unknown, its disturbing force cannot be estimated, though it is less than that of Jupiter. But the combined influence of all the rest of the solar system is, from their great distance, incomparably smaller.

Inefficacy of the Stellar Influence.

Nothing can be so utterly groundless, therefore, as the disposition to refer the ordinary changes of the weather to the influence of the moon. But, compared with this, the fancied efficacy of the stellar aspects, which was for ages firmly believed by the learned world, vanishes into the shadow of a vision. Nor has the most elaborate examination of numerous registers of the weather disclosed any precise and constant connection between the phases of the moon or the positions of the stars, and the succession of atmospherical phenomena. The inferences which seem to indicate a different conclusion, may be fairly disregarded, as drawn only from a loose and imperfect inspection of facts.

Cycles of the Weather.

It cannot be disputed, however, that all the changes which happen in the mass of our atmosphere,—involved, capricious, and irregular as they may appear,—are yet the necessary results of principles as fixed, and perhaps as simple, as *those* which direct the revolutions of the solar system. Could we unravel the intricate maze, we might trace the action of each distinct cause, and hence deduce the ultimate effects arising from their combined operation. Without the possession of such data, we might safely predict the state of the weather at any future period, as we now calculate an eclipse of the sun or moon, or foretell a conjunction of the planets. After the protracted chain of combinations has been completed, the same series of events must again be repeated through the boundless lapse of ages. As all the anomalies of the planets are periodical, so likewise the successive varieties follow some cycle of vast extent. In the remotest annals of atmospherical phenomena, we might descry a gleam of futurity, and read the changes which still lie hid in the womb of time.

But, besides this great cycle, there probably are much shorter interior and subordinate periods, in which the weather nearly, though not absolutely, returns after the same order. Whatever principles concur to modify its succession, the revolutions of the sun and moon are certainly the primary and predominant causes. The character of the weather is accordingly strongly marked by the vicissitudes of day and night, and by the annual repetition of summer and winter. The menstrual action of the moon escapes correct observation; but, accumulated during a sufficient time, it may possibly produce a decided influence. Every 19 years the motions of the moon come to coincide with those of the sun, and her nodes perform their revolutions in nearly the same time, or about 18 years. This period, or the half of it, has therefore not improbably some slight connexion with the usual series of the changes of the weather.

"If the sages of antiquity be justly blamed for adopting implicitly the notions and prejudices of the vulgar, those of modern times may be charged with too eager a disposition to reject whatever savours of popular opinion. A collection of the numerous rules and remarks formed in the course of ages among different orders of men, deeply interested by their occupations in watching the changes of the sky, would undoubtedly contain some important truths, which the diligence and sagacity of the philosopher might discriminate, and employ for the basis of beneficial speculations. The most sanguine can hardly uphold the prospect that mankind will ever arrive at such a pitch of knowledge, as to be capable of prognosticating the future modifications of the atmosphere, with the same precision with which they can foretel the successive revolutions of the heavenly bodies; yet the motions, however irregular in appearance, which prevail in the element that we breathe, are, equally with those performed in the regions of space, the result of certain fixed laws. The variable aspect of the sky proceeds partly from the direct action of the sun-beams, but principally from the winds which they excite and maintain. The unequal gravitation of the different portions of our atmosphere to the sun, and to the moon especially, must occasion some small effect in producing or altering the aërial currents; and even the disturbing forces of the planets have a remote share, how minute soever, in the formation of meteors. Nor can we hesitate to conclude, with the late ingenious and eloquent M. Bailly, whose fate demands the tribute of a tear, that the notions, so widely spread among men, of the aspects and influences of the celestial bodies, are only the corrupted remains of astronomical science, already advanced to high perfection in some distant age of the world. If motions were to rise and cease instantaneously with the operation of their causes, the same succession of seasons would exactly attend on each revolution of the sun; but the currents of air acquire velocity by degrees, and thenceforth continue to flow till their force is spent. The varied face of our terraqueous globe will, therefore, modify the direction, the power, and the duration of the winds, raised by the action of the solar rays. Hence an extreme complication of causes, which will produce an immense series of fluctuating events. That profound geometer, M. de la Grange, has established by demonstration that all the changes arising from the disturbing forces in the planetary system are subjected to certain vast cycles, on the return of which the same motions are perpetually renewed. Similar periods, but of an extent that affrights the imagination, probably regulate the modifications of the atmosphere; for, whenever a coincidence of circumstances prevails, the series of appearances must inevitably recur. The aggregate labours, indeed, of men continually transform the face of our globe, and consequently alter the operations of natural causes:—but, if the agency of animals be stimulated and determined solely by the influence of external objects, it follows that the re-actions of living beings are comprehended in the same necessary system, and that all the events within the immeasurable circuit of the universe are the successive evolution of an ex-

tended series, which, at the returns of some vast period, repeats its eternal round during the endless flux of time. Besides the grand cycle, there must evidently be many intermediate smaller periods, at the lapse of which our atmosphere will present nearly, though not exactly, the same fleeting aspects. Whether these bear any decided relation to the lunar revolutions, cannot with certainty be affirmed. A copious collection of registers formed in the course of ages will probably, at some future time, lead to the discovery of certain remarkable periods, which will enable men to conjecture, with tolerable precision, the succeeding changes of the weather. It would be most advisable, perhaps, to begin the inquiry with the tropical countries, in which the seasons are more uniform, and to advance by degrees into the temperate climates. In the mean time, our prognostications may be greatly assisted by observing and studying the concatenation of *phenomena*. Certain coincidences of aspects mark the near recurrence of some small portions of the general series, and afford scope for the doctrine of chances." (*Monthly Review for September* 1795, Art. I. p. 14.)

Necessity of recurring to Correct Observations.

Such views of the cyclical returns of the varied seasons may expand the imagination, but will be considered rather as curious speculations, than as definite conclusions which can ever be reduced to real and actual application. To improve meteorology we must submit to tread a humbler path; we must study closely, and by the aid of delicate instruments, the constitution and modifications of the atmosphere, and pursue, under various circumstances, and in different parts of the globe, a lengthened train of careful and precise observations. The ordinary registers of the weather are of a very modern date, and besides being for the most part unskilfully kept, they seldom record more than the state of the barometer and thermometer, which afford not any complete indication of the disposition of the atmosphere. No wonder that meteorology, though cultivated from the earliest times, has advanced the most slowly to the perfection of science.

To prepare the way for establishing meteorology on a solid basis, we shall *first* inquire into the extent and constitution of the medium which we breathe; and shall *next* review the different philosophical instruments which assist external observation, and indicate at all times the exact condition and qualities of that mutable fluid.

Height of the Atmosphere li-

The ancients imagined that our atmosphere, the seat of care, mortality, and corruption, reached as far as the moon, beyond which was a boundless expanse of resplendent æther, the abode of celestial beings, exempt by their nature from all anxiety, and absorbed in the enjoyment of eternal bliss. But the discovery of the weight and pressure of the air destroyed at once this magnificent vision. Comparing the length of the mercurial column with the density of the aerial medium, it followed, that if the atmosphere had been an uniform fluid it could not exceed the elevation of five miles. But the air being very dilateable, the higher portions of the mass which covers our globe, sustaining a diminished pressure, must swell upwards, and occupy a proportionally wider space. This property hence removes the boundary of the atmosphere to a much greater elevation. By means of an excellent pneumatic machine, air can be rarified about a thousand times; but this degree of rarefaction would not occur below the height of forty-two miles in the atmosphere. Such is nearly the limit deduced from another consideration, first proposed by the famous Kepler. This most original and inventive philosopher conceived, that the depression of the sun below the horizon, when twilight closes around us, might furnish the data for discovering the altitude of the portion of sky which reflects his latest parting rays. Let C (see fig. 2, Plate XCVII.) be the position of a spectator on the surface of the earth, and A represent the point where the sun sets, the tangent AB will mark the track of his lowest ray, which illuminates the upper part of the atmosphere at B, whence the emission of a secondary ray BC will barely reach the ground at A. But assuming the mean estimate of astronomers, that twilight expires when the solar depression or the arc CA amounts to eighteen degrees. In the right-angled triangle COB, the base OC, or the radius of the globe being 3956, and the acute angle COB nine degrees, or the half of AOC the hypotenuse OB is easily found, and hence about 49 miles is the excess BD of CB above CD, or the elevation of the boundary of the atmosphere, illumined by the latest beams of the sun. A correction might be required for the deviation of the rays from their rectilineal path, in consequence of the unequal refraction of the different strata of the atmosphere; but in a question of this kind, resting on rather loose or doubtful observations, it seems superfluous to affect any delicacy of calculation.

Lambert's Investigation.

The inference drawn from the limits of twilight is not so conclusive as might at first appear. The feeble slanting rays, shed from the higher regions of the atmosphere, may not have been received directly from the sun, but derived, after repeated reflexions, from the more distant parts of the sky. The very ingenious Lambert attempted to distinguish, besides the primary twilight, a secondary, and even a ternary *crepusculum*. It is easy to see, that the solar ray SA (Fig. 3, Plate XCVII.), after grazing along the surface, will illuminate the upper atmosphere at B, from which some light will be darted in the direction of the tangent BCD, to tinge another elevated portion of the sky at D, which may cast a few expiring rays to the spectator at E, or shoot onwards to the opposite sky at F, and thence reach in a state of almost extinction the ground at G. While the first *crepusculum*, therefore, sets in the west, the second will travel like a bow over the heavens, followed at a regular distance by the dusky veil of the third, or the vanishing train of the fourth. But it may be computed, from the vast length of the tracks which the light would have to traverse, that those shades would in succession be ten thousand times darker. The clearest sky, however, on the close of evening, never appears marked by such contrasted boundaries. The vault of heaven seems to darken by insensible transitions, from the western to the eastern horizon. It is most probable, therefore, that the diminution of light, after the close of evening, is owing to the prodigious rarefaction of much higher portions of the atmosphere, which still catch some faint rays of the sun, without being able, from excessive attenuation, to reflect them efficiently to the earth. But since, unless the sky be overcast, there is

total darkness in no climate, even at midnight; we may, therefore, infer that the body of air extends to such an altitude, as to receive the most dilute glimmer, after the sun has attained his utmost obliquity, and sunk ninety degrees below the horizon. It would thence follow, that the elevation of the atmosphere, must be equal at least to 1638 miles, or the excess of the hypotenuse of an isosceles right-angled triangle having 3956 miles, or the radius of the earth for its base.

Extreme Elevation of our Atmosphere.

This very great extension of a rare expansive atmosphere appears conformable to the general phenomena. But the thin investure of our globe, at least, near the equator, may stretch out much farther; and yet its elevation can never exceed a certain absolute limit. The highest portions of the atmosphere, which is carried round in 23 hours and 56 minutes, by the rotation of the earth about its axis, would be projected into space, if their centrifugal force at that distance were not less than their gravitation towards the centre. But the centrifugal force is directly as the distance, while the power of gravity is at its square. Consequently, when the centrifugal force at the distance of 6.6 radii of the earth is augmented as many times, the corresponding gravitation is diminished by its square or 43.7 times, their relative proportion being thus changed to 289. Now, the centrifugal force being only the 289th part of gravity at the surface of the equator, it will therefore just balance this power at the distance of 6.6 radii from the centre, or at the elevation of 22,200 miles. On this hypothesis, fig. 7, Plate XCVII. will represent our globe encompassed by its atmosphere, of which the equatorial diameter extends from A and B.

Such is the extreme boundary of atmospheric expansion. Though it surpasses all our ordinary conceptions of the space occupied by that dilateable fluid, it yet scarcely exceeds the twentieth part of the distance of the moon, which was held by the ancients to communicate with our atmosphere. If it really spreads out to the limit now assigned, it must, in its remote verge, attain a degree of tenuity which would utterly baffle imagination to conceive. Perhaps the fluid itself may change in those lofty regions, and pass into a sort of ætherial essence, more analogous to diffuse light than to a mass of air.

Constitution of the Atmosphere.

The constitution of the atmosphere forms the next object of inquiry. The analysis of that rare medium is one of the finest discoveries of modern chemistry. It appears to consist of two distinct expansible fluids combined in different proportions, a single portion of oxygen gas being united to three parts by weight, or four parts by bulk of azote. There is also a very slight admixture of carbonic acid gas, amounting to perhaps the thousandth part of the whole. It may be doubted, however, whether this analysis be complete. The combination of those gases obtained artificially generates a fluid in which we can hardly recognize the ordinary qualities of atmospheric air. Some fugacious elements must therefore escape during the process of decomposition. Indeed, the air may be considered as an universal solvent. It is the medium of all smells, and must therefore dissolve the different odorous effluvia, and transmit them to the olfactory nerves. The presence of moisture may perhaps assist the solution, but the mass of air is still the great receptacle of those diffusive emanations. We can readily distinguish several earths and stones by their difference of smell. Nay, the metals themselves, especially when rubbed, emit peculiar odours. What can be more variously contrasted, for instance, than the smells of iron, of tin, and of copper? The air must hence actually dissolve some traces of those metals, highly attenuated indeed, and almost evanescent. If a lump of *assafœtida* loses but a grain by exposure for several weeks, a bright surface of copper may, in similar circumstances, suffer the waste of only the thousandth part of a grain. The metal, if not encrusted by oxydation, would consequently experience a certain diminution, however small, in the course of ages.

It is charged with various Emanations.

The atmosphere is thus charged with emanations of all the various substances which it sweeps. To detect such dilute corpuscules wholly transcends the powers of chemical analysis. It seems probable, that the air holds some matters in more copious solution than others; and the phenomena of the aërolites lead us to suspect that it attracts iron and nickel with greater force than the rest of the metals. The quantity of those adventitious particles contained in a given mass of air may be exceedingly small, and yet the aggregate weight diffused through the whole atmosphere would form a considerable amount. It appears from numerous endiometrical observations, which agree tolerably well when performed in a similar way, that the constitution of our atmosphere is the same in all places on the surface of the earth, and at every elevation which has been yet explored. Such experiments have been made at very distant points, repeated on the summits of the loftiest mountains, and applied to portions of air brought down by balloons from the altitude of five miles. The result is what we should expect from the perpetual agitation and commixing of the lower strata of the atmosphere.

Its higher Strata Inflammable.

But a variety of circumstances render it extremely probable, that an expanse, far above the region of the clouds, is filled by some peculiar fluid, very different from the grosser element spread below. The shooting stars which are seen every clear night, the *bolades*, or fire balls, and the luminous arches which not unfrequently occur, and which must traverse the sky at the height of several hundred miles, all seem to indicate the existence of a very ignitible medium. Nor is it difficult to conceive how such a collection of highly inflammable fluids could be formed. Not to mention the multiplied processes of art which emit those products, the great laboratory of nature is incessantly at work in generating and pouring forth hydrogen gas, and its various compounds. The volcanic mountains cover a considerable portion of the surface of the globe, and their innumerable spiracles, with scarcely any interruption, continue to discharge immense streams of inflammable aërial fluids, a great part of which escape conflagration. But, as hydrogen gas has little attraction to common air, it rises upwards by its buoyancy, without suffering much loss in the passage through that fluid. The largeness of their volume, and the celerity of their projection, conspire to favour the ascent of those inflammable gases to the loftiest regions of the atmosphere.

A comparison of the several quantities of astrono-

mical refraction, at different altitudes, points to a similar conclusion. The refraction which the rays of light suffer in slanting across the higher regions of the air, is greater than what calculation assigns to the corresponding density of the medium. But the discrepancy would entirely disappear, if we suppose those strata to consist of hydrogen gas, which is known to possess, in a remarable degree, the power of refracting.

It seems very probable, that the higher range of atmosphere has a sort of phosphorescent quality, or shines with a certain feeble light, for some time, after it has been heated or excited by the incident rays of the sun. Such may be the principal cause, and not any reflex illumination, of that lucid glow which, even at midnight, is diffused over the clear canopy of heaven.

Zodiacal Light.

The phenomenon of what is called the *zodiacal light*, might, perhaps, be traced to the same source. That remarkable appearance, which is more conspicuous in the finer climates, and near the vernal equinox, on the approach of evening, has often been ascribed to the extension of a supposed luminous atmosphere about the sun. But Laplace has shown, that such an atmosphere, far from stretching to our earth, would not even reach the orbit of Mercury. The zodiacal light must therefore have only a terrestrial origin. Supposing the uppermost regions of our atmosphere to consist of diffuse inflammable matter, we might infer from analogy, that like the calcined sulphate of barytes and other incinerated substances, they are endued with a phosphorescent quality, and capable of scattering a lambent gleam on being excited by the beams of the sun. But this luminary darting perpendicular rays, will evidently affect most powerfully the range of atmosphere which occurs in his diurnal track. The expansion of the gaseous investure of our globe above the equator, will hence, from its vast elevation, be descried in places even beyond the tropics, glowing with a gentle flame. The luminous cone which converges from the sun to the distance of perhaps 30 or 40 degrees in the circle of the equator, gradually contracts and grows fainter in proportion as that body sinks further below the horizon.

It thus appears, that the opinion entertained by the ancient philosophers concerning the existence of a vast shining æthereal expanse beyond our atmosphere, is, with some modifications, consonant to the principles of sound philosophy. This is not the first occasion in which we have to admire, through the veil of poetical imagery, the sagacity and penetration of those early sages. It would be weakness to expect nice conclusions in the infancy of science; but it is arrogant presumption to regard all the efforts of unaided genius with disdain. Seldom has a discovery been made without some distant ray of anticipation.

Air may occupy the Bed of the Ocean.

Having ventured to state that the highest region of the atmosphere is probably occupied by some very diffuse phosphorescent gas, we shall hazard a conjecture which will appear bolder, and even paradoxical, —that perhaps air, in its most concentrated state, occupies the bottom of the ocean, and forms a vast bed, over which the incumbent waters roll. Air has actually been condensed above a hundred times, and during this process it betrayed no deviation from the fundamental law, that its elasticity is directly proportional to its density. There seems no reason, therefore, to doubt, that if an adequate compressive force could be exerted, air might be reduced to the thousandth part of its ordinary volume. But this elastic fluid would then be denser than water, and, consequently, instead of rising, would fall through the liquid. Suppose, for instance, a bladder filled with air, and having a small bullet attached to it, were thrown into the sea; in continuing to sink, it would reach a depth where the enormous weight of the column of water would compress it to the same density with the surrounding mass; and if the bullet were now disengaged, the bladder would remain suspended in that stratum, or if carried a little lower, it would precipitate itself to the bottom.

Hypothetical Estimate.

To form some estimate of this singular event, a simple calculation will be required. Air, of the ordinary temperature, is 840 times lighter than distilled water, and is therefore 865 times lighter than sea-water, assuming the density of this to be 1.03. But the mean pressure of the atmosphere being equal to that of a column of 34 feet of distilled water, is hence equal to the weight of a column of $32\frac{3}{4}$ feet of sea-water. Wherefore $32\frac{3}{4} \times 864$, or 28,296 feet, is the depth of the ocean where the necessary compression would obtain. But a small correction must be applied, on account of the augmented density of the sea-water itself under the load of such a column. The logarithm of this density is found very nearly by multiplying the height of the column by six, and striking off seven decimal places; whence the *modulus* of the compression of water may be reckoned 723,824 feet. Of this large number, the former depth is about the twenty-fifth part; consequently, to procure an equilibrium between the condensed air and the corresponding stratum of sea-water, it is requisite that the air should be contracted one twenty-fifth part more, or reduced to 901 times less than its ordinary volume. But $32\frac{3}{4} \times 900 = 29{,}475$ feet, from which deduct the fiftieth part for the mean condensation of the column, and there remains 28,885 feet, the correct depth.

This computation is to be considered as only a near approximation, yet sufficiently accurate for the object in view. Nor shall we fatigue our readers by the investigation of a strict formula, including exponentials. It is enough to mark the conclusion, that any portion of air carried five miles and a half below the surface of the sea will never ascend again. Now, this limit is only half the depth which the theory of tides assigns to the waters of the ocean. There is more difficulty in conceiving, by what process air can be conveyed to its abyss. Increase of pressure, however, enables water to hold a larger share of air; and the effect is hence the same as an augmented attraction. The minute globules of air may therefore be gradually drawn downwards from stratum to stratum, till they are at last detached from the body of water by their own superior density. The precipitation and accumulation of concentrated air under the ocean would thus be the results of some unceasing operation. Such a pro-

Meteorology.

cess may perhaps constitute a part of the great economy of Nature. It seems probable, that the existence of a subaqueous bed of air is necessary to feed the numerous fires which continually rage in the bowels of the earth, and occasionally burst forth on the surface in volcanic spiracles.

Meteorological Instruments.

The variable disposition of the atmosphere is the main cause of all the meteorological phenomena. It is of importance, therefore, to examine the theory and application of the different instruments which can be employed to explore the state of that medium. Some of these have been long in common use; but others of a more delicate and refined construction are only beginning to be known, and promise, when generally adopted, to expand our views, by opening a store of new and ulterior prospects. The ordinary observations are confined to the weight and temperature of the air. There are other data still wanted, to determine at any time the actual condition of that medium. The dryness or humidity of the atmosphere, its brightness or degree of illumination, the different depth of the cerulean hue of the sky, and the variable disposition to chill the surface of the earth, by impressions of cold transmitted from the higher regions,—these objects of inquiry should be conjoined with others of a more practical tendency, depending immediately on the mutable state of the weather. Such are the attempts to measure the daily evaporation from the ground, to register the quantity of rain which falls, and to mark the direction and indicate the force or velocity of wind. A complete apparatus of meteorological instruments will, therefore, include primarily the *Barometer, Thermometer, Hygrometer, Photometer, Æthrioscope, Cyanometer*; and comprehend likewise the *Atmometer, Rain-gage, Drosometer,* and *Anemometer.* We shall review this series in the order of enumeration.

Importance of the Barometer.

I. *Barometer.*—The capital discovery of the weight and pressure of the atmosphere achieved by Torricelli in 1643, was the first step in the progress of meteorology to the rank of a science. Prior to that memorable period it rested on principles altogether loose and conjectural. But the construction of the barometer, as an accurate instrument of observation, soon disclosed what was passing in the more elevated and distant regions of the atmosphere. The column of mercury, it was perceived, seldom remained long stationary, but rose and fell through a sensible space, according to the different state of the heavens. In fine calm weather it generally stood high, but commonly subsided a short while before rain or wind. The barometer came, therefore, to be regarded as a *weather-glass,* announcing the proximate changes of the sky, and owed its general reception to this belief. Its indications, however, were found, by farther experience, to be liable to much uncertainty. Though the extreme depression of the mercurial column appears invariably to foretell the ravage of a hurricane, yet its partial variations often pass away without being followed either by rain or wind. The barometer, evidently can mark only the pressure of the atmosphere, and intimate, by consequence, the state of the weather, in as far as it depends on that cause.

Attempts to explain its Variations.

Philosophers have eagerly sought to explain the fluctuations of the mercurial column. They have tried every principle that might appear to exert any influence in modifying the local weight of the atmosphere; but their very numerous attempts, it must be confessed, have hitherto proved singularly unsuccessful. It was requisite to show that such causes would not only give results of the kind expected, but were besides fully adequate to the production of the phenomena. In most instances, however, either none of those effects could have followed, or they would occur in a very inferior degree and disproportionate extent.

Influence of its Heat;

All the proposed explications of the changes of the barometer may, perhaps, be referred to three distinct sources; 1. The action of heat on the atmosphere; 2. The influence of moisture on that fluid; and, 3. The impression made by its rapid motion in wind. Now, the heating or cooling of the air above any given place, could in no way affect its pressure. The only change occasioned would be in the density of the fluid; and by the influx of the portion below, or the efflux of a similar portion above, the pressure of the atmospheric column would soon become adjusted to an equilibrium with the surrounding mass. The diurnal variations of the barometer within the tropics, seldom exceeding the twentieth part of an inch, as they follow a different course from the progress of heat, are obviously not derived immediately from this cause. According to the accurate observations of Humboldt in South America, at all seasons the barometer falls from nine o'clock in the morning till four in the afternoon, it then rises till eleven at night, and from this time it again descends till half-past four in the morning, and next mounts till nine o'clock.

and of its Dryness and Moisture.

The transition of the air, from a state of dryness to humidity, seemed to furnish the most plausible explication of the changes of the mercurial column. But the indication of the barometer was, in this case, distinctly at variance with the ordinary feelings of men. Those who suffer under a delicate or enfeebled constitution are accustomed in damp weather to complain of the air as heavier and less elastic. This language is, no doubt, metaphorical only, and descriptive of the disordered state of the nervous system; but it shows the utter fallacy of trusting in philosophical matters, to the loose results of vulgar observation and experience. Moisture, so far from loading the air by its weight, communicates, like heat, increased expansion, and elasticity. But, even supposing a column of air to become suddenly charged with humidity, before its subsequent dilatation had, by diffusing it, produced an equilibrium, still the additional pressure would have been extremely small, not exceeding, at a moderate computation, the fifteenth part of a mercurial inch. Any transition of that medium, from dryness to humidity, would be quite inadequate, therefore, to the production of the effects actually observed.

Some philosophers imagine that moisture, in separating from the air, ceases to press that fluid by its gravitation, and would hence explain the fall of the barometer on the formation of clouds and the precipitation of rain. But when the aqueous particles are disunited in their solvent, whether dispersed in

Meteorology.

minute globules, or collected in large drops, they must evidently descend till they acquire the celerity sufficient to maintain a resistance in the medium equal to their weight. The pressure of the whole atmospheric mass upon the surface of the earth must therefore continue exactly the same under all the changes of the constitution of the medium.

Action of Winds.

The combined action of winds seem at first to promise the most satisfactory explication of the variations of the barometer. It is evident, that opposite currents rushing to the same quarter, will occasion an accumulation of the air; and on the other hand, different streams flowing from any point must reduce the vertical column. But such conclusions are quite vague, without being subjected to the ordeal of calculation. Now it is easy to compute that a concourse of winds blowing at the rate of 50 miles an hour, and hence approaching to the violence of a hurricane, would be required to raise the barometer only the tenth part of an inch. The utmost power of a tempest could not, therefore, affect the mercurial column the twentieth-part of what is frequently remarked in such circumstances. But trifling as this influence appears, it would be still at variance with actual observation. So far from rising in strong winds, the barometer almost invariably sinks; and instead of continuing depressed in the place where those currents originate, and where a calm must prevail, it generally stands high.

Hauksbee's Experiment.

To explain the descent of the barometer during wind, a very ingenious idea has been proposed, which, being apparently confirmed by experiment, has obtained general reception. It is conceived, that a current of air, in sweeping over the surface of the earth, must cease to exert any vertical pressure. But this assumption can hardly be reconciled with any strict principle in science, for the particles of air will not for a moment cease to gravitate, nor will any horizontal motion of them produce the slightest derangement in a perpendicular direction. A remarkable experiment, however, was made by the ingenious Mr Hauksbee about the beginning of the eighteenth century, "showing, as he says, the cause of the descent of the mercury in the barometer, in a storm." Having connected the square box cisterns of two barometers by a horizontal brass pipe of three feet in length, he inserted in the side of one of the boxes another pipe opening outwards, and connected the opposite side with a pipe attached to the neck of a large globular receiver, into which three or four charges of atmosphere had been compressed. On turning the stop cock, the imprisoned air rushed with vehemence over the surface of the mercury in the cistern, and effected its escape, while both columns fell simultaneously about two inches, and gradually rose again as the force of the blast diminished. From this experiment Mr Hauksbee formally derives four distinct corollaries: 1. "That we have hence a clear and natural account of the descent and vibrations of the mercury in violent storms and hurricanes;" 2. "That not only the different forces, but also the different directions, of the winds, are capable of producing a difference of the subsidence of the mercury;" 3. "That strong winds may affect the animal economy, upon this very account, of their altering the pressure of the atmosphere;" and 4. "That the weight of the atmosphere being diminished in one place, it is also as much diminished at the same time in another place, which holds a communication with the former."

Its Fallacy.

This experiment has a specious appearance, and might seem to warrant the conclusions drawn from it. But a closer examination dispels the illusion. Since the air had been condensed four times, it must issue from the receiver with the immense velocity of 2700 feet in a second, or the double of that with which air of the ordinary density would rush into a vacuum. This is a rapidity, however, twenty times greater than the most tremendous hurricane. The very small change of the four hundredth part of an atmosphere would hence have been sufficient to produce the strongest wind ever observed, and therefore its influence in passing over the mercurial surface must have been quite insignificant.

But the experiment itself was absolutely fallacious. The peculiar result proceeded from a mere casual circumstance, the exit pipe from the mercurial cistern being wider than the pipe which introduced the current of air. This incidental arrangement is not mentioned in the description of the apparatus, and we have, therefore, caused the original figure to be engraved on a reduced scale, not only to prove the fact which we have just stated, but also to warn experimenters of the necessity of noting scrupulously every accessary circumstance blended in their operations. (See Fig. 2, Plate XCVI.) It is easy to perceive that the tube G, which discharges the air from the box F, is much wider than the tube E, which conveyed it from the receiver A. This air, previously condensed, and still restrained in its passage through E, on entering the cavity of the box, immediately expands beyond the limit of equilibrium, and finding an easy escape through G, allows that state of dilatation over the mercury during the time of the horizontal flow. But the air contained in the other cistern K, must, from its communication by the slender pipe I, suffer a like expansion, and, consequently, the columns L and H will, in the same time, subside equally.

Similar Experiment.

Such is unquestionably the true explication of this curious fact. Were any confirmation needed, it could easily be derived from a very simple experiment. Let A (Fig. 3, Plate XCVI.) be any cylinder of tin, suppose three inches long and two inches in diameter, having an open pipe inserted at B, a quarter of an inch wide, and perhaps two inches long, and another opposite pipe inserted at C, about three-eighths or half an inch wide, and one inch long; at right angles to these, a recurved glass tube or syphon, G H E, of the tenth of an inch bore, is cemented below, descending 12 inches, and rising again 6 inches to the open swell at E, which contains coloured water terminating at F. Holding the cylinder in a horizontal position, and applying the mouth at B, let a sudden blast be injected into the cavity, the water will rise instantly to G, thus showing the diminished pressure, and, consequently, the rarefaction of the air above it. But if a cap D, with a narrow projection of perhaps only the eighth part of an inch, be adapted to the exit pipe C, on repeating the expe-

Meteorology.

ment, an opposite effect will take place, and the column of water, so far from mounting to G, will now sink to H. It is evidently the difficulty of the escape through D, that occasions the accumulation of the air within the cylinder, and the consequent depression of the water in the syphon. These different results are perfectly analogous to the local fall or rise of the surface of a river occasioned by the widening or contracting of its channel.

New Theory of the Variation of the Barometer.

After the complete failure of so many theories for explaining the variations of the barometer, which it would be tiresome to enumerate, we may be charged with presumption in attempting the solution of a problem that has racked and exhausted so much ingenuity. Yet in all these various efforts, a principle seems to have been overlooked, of extensive influence, accordant with the general phenomena, and sufficient, we think, on a close investigation, to produce the measure of effect which is required.

It is obvious, that a horizontal current of air must, from the globular form of the earth, continually deflect from its rectilineal course. But such a deflection, being precisely of the same nature as a centrifugal force, must hence diminish the weight or pressure of the fluid. The only question is to determine the amount of that disturbing influence. Though it should appear quite inconsiderable in the interval of a short space, it may yet accumulate to a very notable quantity through the wide extent over which the same wind is known to travel. Suppose a current to begin to flow from A (fig. 9, Plate XCVII.) in the direction of a tangent, it will successively bend from a rectilineal track at the points B, C, D, E, F, G, &c. on the surface of the earth. The particles of the fluid are, therefore, drawn incessantly from their course by the action of gravity. Their vertical pressure is consequently diminished, by the force spent in producing this deflection. Wherefore, during the prevalence of the wind, the atmospheric column will press with inferior weight at B than at A, at C than at B, at D than at C; thus gradually decreasing through the whole chain. Suppose the intervals AB, BC, CD, DE, &c. to be each of them a mile, and that the current reaches the points B, C, D, E, &c. in successive minutes, a celerity which frequently happens; the deflection at B, owing to the curvature of the earth, would be eight inches, or two-thirds of a foot; but the space through which a body would descend in a minute, by the action of gravity, is $60 \times 60 \times 16 = 57600$ feet, or 86400 times greater than the deviation from the tangent. Wherefore the atmospheric pressure would, on that hypothesis, be diminished by the 86400th part for each interval of a mile, from A to G. In the space of 288 miles this diminution would, consequently, be the 300th part of the incumbent weight; and over an extent of 2880 miles it would amount to the 30th part. If we assume the very probable estimate, that storms involve the whole region of the clouds, or attain an elevation of near three miles, the diminution of pressure, occasioned by a long series of deflections in the stream, would affect one-half of the atmosphere. Wherefore, a wind which has blown over a track of 2880 miles, at the rate of 60 miles an hour, might cause the mercurial column to subside half an inch. If the velocity of the wind were doubled, which is probably the limit of the most tremendous hurricane, the fall of the barometer would be four times greater, and amount to two inches.

That the same powerful wind can sweep over an immense track of surface is well ascertained. The effects of a hurricane originating in the West Indies, at the distance of 5000 miles, have often been felt on our shores. But a wind arising at A must evidently be followed, at succeeding intervals, by a current from K, L, M, &c., the range of influence being thus extended over a larger track. During the flow of the air, the depression of the barometer at G will be maintained, or rather augmented.

Variation of the Barometer, the same over a great extent.

These conclusions are perfectly accordant with the facts observed. It appears from comparing the most accurate registers, that the pressure of the atmosphere is subject to very nearly the same variations through a vast extent. A barometer may be considered as in unison with another placed at the distance of perhaps 200 or 300 miles, and the mercurial columns in both of them rise and fall by an almost simultaneous movement. But, in stormy weather, the separated barometers, however they may approximate in their indications, cannot absolutely correspond. The gradation of atmospheric pressure from G to F, from F to E, &c. may be very slow; and yet the minute differences may accumulate to a very sensible amount in the long range from G to A, or to M. Thus, though a barometer may stand only the twentieth part of an inch lower than another separated 200 miles, it would be half an inch below a barometer at the distance of 400 miles.

The theory now stated seems to furnish the most satisfactory explication of a great variety of phenomena. Thus the minute diurnal alternations, to which the barometer is subject within the Tropics, are caused by the influence of the land and sea breezes. During the heat of the day, those gentle airs blow from the ocean, and, therefore, near the shore, and in the interior of the islands, the mercurial column subsides. But after the vigour of the sun's beams has declined, they flow in an opposite direction, and consequently the mercury rises again. The fluctuations are only partial, however, because such breezes hold a very short, and do not perhaps extend beyond 100 or 200 miles.

The common remark that a north-east wind, so far from depressing the mercurial column, generally causes it to rise, might appear at variance with the principles which we have advanced. But that wind which really comes from the north has probably a short course, and may be dependant on a more extensive current which maintains a flow in the higher regions towards the poles. The existence of opposite streams, though incompatible with the supposition of a wide spreading hurricane, may yet be admitted in local and partial derangements of the atmosphere.

Hitherto we have contemplated the winds, as describing only arcs of great circles about the earth; but they may be constrained to bend in smaller circles, and perhaps trace the parallels of latitude. Their flexure from a rectilineal course, being in this case augmented, they would in the same extent exert an influence proportionally greater on the barometer. Such, near the arctic regions, may

Meteorology.

be the effect of a westerly wind of no very distant origin.

Explication of Whirlwinds.

The same principles will explain the phenomena of eddies, whirlwinds, and tornados. Suppose (Fig. 4, Plate XCVII.) a horizontal stream of air, rushing from A to B, meets a contrary current blowing from C to D, and that some obstacle, E, occurs in their line of separation. The flow will evidently diverge on both sides of E (see Figs. 5 & 6, Plate XCVII.), till it swells by degrees into a vertiginous revolution. Such is the origin of the famous *malstroem*, or whirlpool, on the coast of Norway, occasioned by the meeting of opposite tides. The aërial vortices are evidently produced by a similar cause. If the opposite streams have equal force, the circulation will be maintained in the same spot; but if the one current flows with greater rapidity than the other, it will transport the vertiginous motion by the excess of its celerity. A motion of progression and revolution is thus upheld at the same time. Such appearances are frequently witnessed in summer, especially in the hotter climates. A whirlwind arises on a sudden, and runs over the surface of the ground, drawing into its vortex all the light substances which occur in the track. Immense havoc is often thus produced in the fields of rice and plantations of sugar-cane. It is easy to show, that if r denote in feet the radius of the extreme circle described by the whirlwind, and t the time of circumvolution in seconds, the elasticity, or pressure of the column at the verge, will suffer a diminution corresponding to the fraction $\frac{5r}{4t^2}$. The amount of this diminution over the whole base would be reduced to three-fourths; and consequently h expressing the height of the revolving column of air, $\frac{15rh}{16t^2}$ would represent the mean effect of centrifugal action. Suppose the whirlwind to have an elevation of 200 feet, and a radius of 50, and to circulate in three seconds, the diminished pressure would be equal to the weight of a column of $\frac{15.50.200}{16.9}$, or 1040 feet. This example, assuming a celerity of 65 miles an hour, might be reckoned an extreme case, but it would occasion the mercury to sink in the barometer more than an inch, or 1.12.

The formula for the depression of the barometer caused by a rapid whirl or tornado in the lower atmosphere, may be changed into an expression that shall embrace the velocity instead of the time of revolution. This velocity in miles each hour being denoted by v, the diminished pressure of the vertiginous column will be $\frac{3v^2h}{50r}$. It thus appears that the effect is directly as the square of the celerity, and inversely as the radius of circumvolution. And since the rapidity of whirl can never exceed certain limits, the action of a tornado must diminish in proportion to the extent of surface which it occupies. Suppose the height of the cylinder of air to be 300 feet, the radius of the sweep 500 feet, and the celerity of its extreme circulation 80 miles an hour: Then $\frac{3.6400.300}{50.500}=230$ feet, which corresponds to a descent of 1.247, or about a quarter of an inch in the mercurial column.

II. The Thermometer.—The invention of this instrument has not only dispelled the illusions which formerly prevailed on the subject of heat, but has mightily contributed to extend our acquaintance with the actual condition of the atmosphere. A lump of iron brought into the house, from its exposure during a frosty night, feels intensely cold, yet becomes gradually warmer; and if it be put into the fire, it will soon grow extremely hot, till it acquires the faculty of burning; on removing it from the fire, and laying it again out of doors, it will, through all the steps of a contrary progress, relapse imperceptibly into its former state. This obvious fact, and many others of a similar kind, might have been sufficient to show that *hot* and *cold* are nearly relative conditions which every substance is capable of assuming. The schools upheld very different notions, which, after a long series of descents, have at last found shelter among the vulgar. It was maintained that, of the four elements, air and fire are hot, and water and earth essentially cold; and that the compound bodies, from their constitution, partake of those qualities in different degrees. While the senses were the sole arbiters of heat and cold, substances became classed according to the sensations which they excited. If a body, such as lead, rapidly abstracted heat from the touch, it was reckoned cold. But the same quality was likewise bestowed on other substances of a very different kind, for instance, on vinegar and hemlock, because they affect the stomach with a sort of chilling sensation. Soft wood and feathers might be deemed warm, since they draw off heat feebly from the touch; but pepper was also ranged in the same class, because it stimulates the organs of taste. Such a confusion of ideas disfigured physical science, and perverted the practice of medicine.

Invention of the Thermometer.

The construction of the air-thermometer, by the famous Sanctorio of Padua, in 1590, was the commencement of a salutary revolution. As it was at first intended for exploring disease, it has ultimately rendered signal service to the medical practitioners. About twenty years afterwards, those instruments were manufactured by Drebbel, who carried them from Holland into England. They were very rude, however, and adapted to no constant scale, but regarded merely as *weather-glasses*. The discovery of the barometer opened new views, and showed that the former instruments marked the conjoint effects of heat and pressure. To distinguish the separate influence of heat, it became hence requisite to employ some different fluid from air. Alcohol was preferred, as being very expansible; and from the year 1655, thermometers consisting of rather wider tubes, terminating in balls or large bulbs filled with that liquid, were manufactured by Italian artists, who imitated an arbitrary standard adopted by the *Academia del Cimento*. Such thermometers were clumsy, and susceptible of only a low range. Römer, who made the fine discovery of the progressive motion of light, proposed mercury as a fluid, sufficiently expansible, and capable of bearing an intense degree of heat. The origin of the scale was then fixed at the melting point of ice or snow, and the scale itself divided into

Meteorology.

degrees corresponding to the ten thousandth parts of the capacity of the bulb. Yet this mode of construction seemed tedious, and liable to some inaccuracy. The capital improvement was made in 1724 by Fahrenheit, who took another standard point from the boiling of water under the mean pressure of the atmosphere. For many years that ingenious artist manufactured thermometers in Amsterdam on correct principles, very neat and small, adapted especially to medical purposes. The multitudes of young physicians who at that period studied in Holland, quickly dispersed them to every part of the globe. The observations thus obtained gave juster ideas of the comparative temperatures of different climates, and in many cases reduced the exaggerations of travellers to moderate bounds. It thence appeared that the heat of the torrid zone was not so excessive, nor the cold of the arctic regions so intense, as had been commonly represented. The tropical plants could, therefore, enjoy in our hot-houses all the warmth of their native climate. The thermometer was first applied to direct the operations of horticulture, and afterwards extended to regulate the process of brewing and other arts more immediately depending on practical chemistry.

Improved by Fahrenheit.

Quicksilver was deemed preferable to alcohol in the filling of the thermometers, not only because of the wide range which it embraces, but on account of the remarkable property which it was afterwards found to possess, of expanding equably with equal accessions of heat. But it failed in the lower part of the scale. The reported sinking of the mercurial thermometer in Siberia appeared to indicate an intensity of cold beyond all conception. But the discovery made by Professor Braun, in 1759, of the actual congelation of mercury itself, reduced the extent of refrigeration to moderate limits. This fluid metal suffers a large contraction in passing into the state of solidity; and, therefore, though it freezes about 39 degrees below the zero of Fahrenheit, it yet shrinks through a space of more than a hundred degrees before it becomes fixed. As alcohol has never been congealed, though brought, in some experiments we could mention, to 150° below zero, thermometers filled with it are now employed to explore, if not to measure, intense cold.

Metallic Thermometers.

Metallic thermometers are likewise well adapted for examining the state of the atmosphere. They are commonly constructed on the principle of the compensation balance of a chronometer, a spiral or circular spring being composed of two soldered opposite plates of distinct metals, for instance of brass and steel, or of zinc and platinum, which expand very differently under the action of heat, and therefore continually change their incurvation. Some instruments of this kind, made by Breguet at Paris, are remarkably elegant, and those more lately manufactured by that ingenious artist with a very slender form, surpass all other thermometers in the exquisite sensibility of their indications. Fig. 9, Plate XCVI. represents the first form, reduced to about the fourth part of its natural size. The main piece of mechanism is a circular spring, fixed at one end, and composed of steel and brass soldered together. The other end carries a clip, that acts on a short train of wheels, which turn an index on the dial plate, the extent of the scale, including the range of atmospheric temperature. The dial with its index are shown by A; and B exhibits generally the interior mechanism. Fig. 4, Plate XCVI. delineates the latest improvement. To prevent the cracking, or dislocation which a large motion of the spring sometimes occasions at the junction of the two metals, a thin plate of a third metal is interposed. Three plates, consisting of platinum, gold, and silver, are united by the rolling press into a single ribband, of the thickness of only 1200th part of an inch. The instrument is formed with about twenty-seven spires or circumvolutions of this very slender spring, bearing an index which travels in its circle over 50 centesimal degrees, or 90 degrees by Fahrenheit's scale. The metallic film is, from its extreme tenuity, almost instantly penetrated by the impressions of heat or cold, and the sensibility of this thermometer accordingly surpasses all conception.

Registering Thermometers.

It is of much importance in keeping meteorological journals, to have thermometers that shall indicate the extreme changes which occur during the absence of the observer, such as the greatest heat of the day, and the lowest cold of the night. For this object, the metallic thermometers are easily adapted, since their index may push forward or draw back any moveable mark, and thus indicate the limits of its variation. Large mercurial thermometers also, if mounted like the wheel barometers to turn an index, will answer a similar purpose. But smaller instruments, though of a more complex construction, have been generally preferred. The *Encyclopædia* contains a sufficient account of the Self-registering Thermometer proposed by Lord Charles Cavendish in 1757, and of the more complete instrument described by Mr Six in 1782. The latter has now come into pretty general use, though we are sorry to remark, that it seems to have fallen into the hands of very inferior artists, the scale consisting merely of boxwood, rudely and inaccurately subdivided.

Both these instruments have been employed to ascertain the coldness of the ocean at great depths. It becomes requisite, however, to make some allowance for the contraction which the glass bulbs must suffer under the enormous compression of the superincumbent columns of water. This can easily be computed, from the effect of perhaps ten atmospheres in a condensing engine; and such corrections were actually applied to the observations made in Captain Phipps' voyage in 1773 towards the North Pole. It is a matter of equal surprise and regret, that all such niceties were overlooked in the late expeditions of Captain Ross and Captain Parry to the arctic regions.

Those of Rutherford

The simplest, and by far the best self-registering thermometers, though barely noticed in the *Encyclopædia*, are those invented and constructed by the late Dr John Rutherford, of Middle Balilish, and first described in the *Transactions of the Royal Society of Edinburgh*, for the year 1794. The one which marks the *minimum* is filled with alcohol, and the other which indicates the *maximum* is filled with quicksilver; and they are both attached to the same frame, or, what is still better, affixed to separate frames, placed nearly horizontal, or rather elevated about five degrees, to prevent the separation of the thread of liquid. The tubes have bores from the 25th to the 15th part of an inch wide, and include a minute tapered or conical piece of ivory, or of white

or blue enamel, about half an inch long. This mark having in either thermometer its base turned towards the bulb, is drawn to the lowest point by the alcohol, which again freely passes it; but it is always pushed forward to the highest limit by the mercury, which afterwards leaves it. These marks, however, are now made cylindrical, a little thickened at the ends, and about $\frac{3}{8}$ths of an inch in length. (See fig. 7 and 8, Plate XCVI.) Fig. 7 exhibits the alcohol or *minimum* thermometer; and fig. 8 the one which indicates the *maximum*, and is filled with quicksilver.

This instrument was first employed by Dr Rutherford in some interesting experiments, to ascertain the temperature of germination, and determine the depth to which frost penetrates into the ground in different soils and situations, at the suggestion of his neighbour, Dr Coventry, the very able and intelligent Professor of Agriculture in the University of Edinburgh, both of them proprietors in the small county of Kinross. The few instruments of this kind, for some time circulated, were made by the hands of the inventor; but artists have since learned to imitate and improve the original construction, and nothing is wanted now but to promote their diffusion. We regret that this very useful register-thermometer seems yet to be not so well known in London as it deserves.

Differential Thermometer.

The minutest changes which take place in the constitution of bodies are for the most part attended by corresponding alterations of temperature. To explore those abstruser operations of nature, which often betray the influence of more extensive principles, it was now requisite to improve the delicacy of the thermometer. To this object the writer of the present article had early turned his attention. At first he enlarged the capacity of the bulb, and thus procured degrees of such a size on the stem as to be capable of a very distinct subdivision. These instruments, however, received their impressions very slowly; and, therefore, tubes of extremely fine bores being selected, he had small bulbs blown, and filled with quicksilver, not in the ordinary way, but by the aid of a compressing force. With such exquisite thermometers, it was easy to procure much nicer observations, and to detect even the finer modifications of corpuscular action. But to include the usual range of temperature, it was necessary to draw the stem to an immoderate length. The attempt to remedy this inconvenience led to the construction of the first kind of *differential thermometer*. The main object was evidently attained, if the mercury should always be made to start from some given point. The tube was, therefore, left open, and a cap adapted to the top containing a surplus portion of the fluid. When the thermometer was kept inverted, this mercury closed round the orifice, and joined the thread in the stem, as in fig. 17, Plate XCVI. But when the instrument was reversed, the excluded fluid instantly separated, and sunk into the cavity under the top of the tube, as in fig. 16. In this situation, the descent of the mercurial thread in the stem marked the depression of temperature.

A differential thermometer of this construction was used for three or four years, in a variety of experiments, without ever failing. But an open thermometer must be liable to some uncertainty, and unavoidably subject to a continual deterioration. The loose mercury will undergo a slow oxydation, while the bore of the tube is apt to be soiled and tarnished by the insensible introduction of moisture. Such an instrument, however, is well adapted for many researches.

Its Simplest Form.

In the beginning of the year 1795, another form of the differential thermometer was devised, which, from its simplicity, its delicacy, and extensive application, has contributed essentially to the progress of physical and chemical science. This instrument is now so generally known, that a few remarks on its general construction will be here judged sufficient. The *differential thermometer* is a modification of the air thermometer, but susceptible of the impressions of heat only, and exempt altogether from the influence of the variations of atmospheric pressure. The tube to which the scale is applied has a bore of equal calibre, from the 50th to the 15th part of an inch wide, the other branch being commonly wider; the terminating balls are not less than four-tenths of an inch in diameter, and seldom exceeding an inch and a half. A glass tube, terminated by a ball containing air, is joined hermetically, or by the flame of a lamp, to another longer tube, terminated by a similar ball containing air also, but including a small portion of some coloured liquid. The tubes are then bent, generally into a recurved or double stem like the letter U, and the liquid is adjusted to the proper height, by making bubbles of air pass from the one ball to the other, from the little enlargement of the bore left at the junction of the tubes. If both balls have the same temperature, the liquid must evidently remain stationary, but if the ball of the shorter tube be warmed, the air, expanding and exerting more elasticity, will depress the liquid in the stem; or if this ball be cooled, the air, by its contraction, allows the liquid to ascend, from the superior elasticity of the air contained in the opposite ball. The fall or rise of the liquid will, therefore, mark the excess of heat or cold in the adjacent ball, and the space through which it moves will measure the precise difference of temperature.*

Its progressive Improvement.

Alcohol and other volatile fluids were avoided in filling the tube, lest their vapour should affect

* It is not difficult to compute, in general, the size of the scale of the differential thermometer. Let the diameters of the two balls be expressed in inches by a and b, the diameter of the bore of the tube being denoted by d, and the measure of a centesimal degree by x. The capacities of those balls, π representing the ratio of the circumference to the diameter of a circle, would hence be $\frac{\pi a^3}{6}$ and $\frac{\pi b^2}{6}$; and the portion of liquid raised through the space x would be $\frac{\pi d^2 x}{4}$ Consequently the opposite elasticities exerted are $\frac{3d^2x}{2a^3}$ and $\frac{3d^2x}{2b^3}$, or expressed by the altitudes of a column of sulphuric acid, of which 220 inches may be reckoned equiva-

unequally the elasticity of the air contained in the balls, and thus disturb the accuracy of the indication. Linseed oil, tinged with alkanet root, was first used; but it was found to be sluggish in its movements, leaving along the inside of the tube a sort of trail, which sometimes collected into globules. But the great objection to this and other fixed oils was, that they did not remain at the same point of the scale, but slowly shifted their place, owing, apparently, to a partial absorption of air in one of the balls, while their orange tint was found to fade away by exposure to the light. Deliquiate potash, coloured with archil, was next employed, and with tolerable success. By degrees, however, it deposited the colouring matter, and became almost limpid. Hydrogen gas, instead of common air, was then adopted for filling the balls. This mode of construction prevented the deposition of the colouring matter; but it was experienced to be troublesome, and attended with other impediments. After numerous discouraging trials, it was at last discovered, that strong sulphuric acid, tinged with carmine, fulfils every condition, remaining permanently stationary in contact with confined air, and never losing in the slightest degree its colour from the action of the strongest light. Since the year 1801, this liquid has been constantly used in the construction of the differential thermometer. When the exhibition of striking effects, rather than scrupulous accuracy, is sought for, tinged alcohol, indeed, has in a very few cases been preferred, on account of the great facility and amplitude of its motions. But in every instance, a column of liquid, terminating in the cavity of one of the balls, or in a small cylindrical reservoir under it, was preferred, and not, as proposed by some experimenters, a single drop of the liquid, which forces its way through the bore by successive starts, and is therefore liable to much uncertainty and derangement.

Meteorology.

Its Different Forms.

The differential thermometer is capable of some diversity of form. It may consist either of a single branch, pendant or horizontal, or it may be bent into two perpendicular branches, whether contiguous or placed at a short distance. Since the motion of the column in the tube is occasioned by the difference of the elasticity of the air contained in the two balls, it is not essential that those balls should be of equal dimensions, for an equipoise must obtain whenever the augmented elasticity of the air of the hotter ball is balanced by its expansion, on the one hand, and the corresponding contraction in the opposite ball, joined to the pressure of the ascending column of the sulphuric acid. In general the balls are blown to a certain degree unequal, either to suit the particular instrument, or to please the eye; but in making observations, it must be kept invariably in the position for which it was designed, whether vertical or horizontal, since the pressure of the balancing column would be affected by an obliquity.

The differential thermometer, in its pendant form, and extended to a suitable length, from one foot, perhaps, to three or four feet, may be employed with great advantage in comparing the different temperatures of adjacent strata of air near the surface of the earth, during the progress and decline of the day; and to detect the variations in a cloudy or a clear sky, and those occasioned by winds, as modified by the quality of the ground, whether naked or clothed with vegetation. But the main use of this instrument in meteorological researches arises from the various modifications of which it is susceptible. The minute changes of temperature which it marks discover the existence and intensity of other disturbing causes. It is thus found, that fresh ploughed ground is more affected by the solar rays than a green sward, on which also the breeze has little influence.

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lent to the weight of the atmosphere, they become $\frac{660d^2x}{2a^3}+\frac{660d^2x}{2b^3}$, or $\frac{330d^2x}{a^3}+\frac{330d^2x}{b^3}$, wherefore, since air expands one 250th part for each centesimal degree, $\frac{330d^2a^3x+330d^2b^3x}{a^3b^3}+x=\frac{220}{250}$, and by reduction $x=\frac{22a^3b^3}{8250(d^2a^3+d^2b^3)+25a^3b^3}$. This corresponds to ten of the millesimal degrees adopted for the differential thermometer, but the length of an hundred of those degrees which may be preferred as a larger basis for the scale will be $\frac{44a^3b^3}{1650(d^2a^3+d^2b^3)+5a^3b^3}$. Suppose $a=\frac{3}{4}$, $b=\frac{4}{3}$, and $d=\frac{1}{35}$, of an inch; then

$$\frac{44\times\frac{27}{64}\times\frac{64}{27}}{1650\left(\frac{1}{1225}\right)\left(\frac{27}{64}+\frac{64}{27}\right)+5\times\frac{27}{64}\times\frac{64}{27}}=\frac{44}{\frac{1650}{1225}\times\frac{4825}{1728}+5}=\frac{44}{3.76+5}=5 \text{ inches.}$$

If the balls be of equal diameters, this expression for the length of an hundred degrees in inches will become simply $\frac{44a^3}{3300d^2+5a^3}$. Thus, suppose $a=\frac{4}{5}$ and $d=\frac{1}{30}$ of an inch; then $\frac{44\times .512}{\frac{3300}{900}+5\times .512}=3.62$ inches. If the density of the sulphuric acid were reduced from 1.85 to 162, the expression for the length of ten degrees would pass into this very simple form $\frac{a^3}{756d^2+a^3}$.

III. The Hygrometer.*—The mutable condition of the atmosphere, as it inclines to dryness or humidity, is the main source of all the variety of meteorological phenomena. The changes which it undergoes with respect to moisture have a marked influence on a very numerous class of substances, and even on the animal frame. But unfortunately those indications are always vague, and often fallacious. To ascertain the portion of humidity which a given quantity of air holds, or is capable of sustaining, is a problem of the first importance; but our advances to the constructing of an instrument fit to measure with accuracy that disposition have been extremely slow.

Most substances of a loose and spongy texture, or possessed of an absorbent quality, are affected, though in very different degrees, by the presence of humidity. Accordingly the variations, both in weight and bulk, which absorbent bodies undergo, have been employed to indicate the disposition of the air with respect to moisture. For this reason, such substances are likewise termed *hygroscopic;* since they are always affected by the state of the ambient medium, though they may not precisely measure its degrees of humidity or dryness. But neither heat nor moisture is passively diffused, or yet shared among different bodies in equal proportions. From some experiments made by Professor Leslie, it appears that, under a like change of circumstances, 100 grains of ivory will attract from the atmosphere 7 grains of humidity; the same weight of boxwood, 14 grains; of eider down, 16; of wool, 18; and of beech, 28. Other substances, in their respective measures of absorption, exhibit still wider differences.

Hygroscopes.

The dry or humid state of the air is therefore discovered, from the variable weight of certain bodies exposed to its influence. Rock salt has been applied to that purpose; but potash, the muriate of lime, sulphuric acid, and most of the deliquescent substances, whether in a solid or a liquid form, act the most powerfully. Other materials of a firm or adhesive consistence manifest the same properties, though in a lower degree. Plates of slate-clay or of unglazed earthen-ware, the shavings of box or horn, paper or parchment, wool or down,—all act as hygroscopes. But these substances, especially the harder kinds of them, unless they be extremely thin, receive their impressions very slowly, and hence they cannot mark with any precision the fleeting and momentary state of the ambient medium. Nor is the weight which they gain by exposure proportioned to the real dampness of the air; for the measures of their successive absorption are found to increase in a most rapid progression, as they approach to the point of absolute humidity.

But to weigh the substances with the accuracy befitting such experiments, is a very delicate and troublesome operation. Those thin bodies are liable, besides, to become in time covered with dust, which, while it must evidently augment their weight, cannot be detached from them without injuring their slender texture. The increase of bulk which they acquire from the portion of moisture attracted into their substance, furnishes therefore a more certain and convenient indication of the state of the atmosphere. The solid vegetable and animal fibres are connected by a fine soft netting, in which the power of absorption appears chiefly to reside. Hence the presence of moisture always enlarges the breadth of such substances, without affecting in any sensible degree their length. This effect is visible in the swelling of a door by external dampness, and in the shrinking of a pannel from the opposite cause. But the substances, such as paper or parchment, which have a diffuse or interlaced texture, are extended, by the absorption of humidity, almost equally in every direction. On the contrary, twisted cord and gut, being swelled by moisture, suffer a corresponding longitudinal contraction, accompanied likewise, if not confined, by some uncoiling of their fibres.

All these properties have severally been employed in the construction of hygroscopes. The expansion of the thin cross sections of box or other hard wood, the elongation of the human hair or of a slice of whale-bone, and the untwisting of the wild oat, of cat-gut, of a cord or linen thread, and of a species of grass brought from India,—have at different times been used with various success. But the instruments so formed are either extremely dull in their motions, or if they acquire greater sensibility from the attenuation of their substance, they are likewise rendered the more subject to accidental injury and derangement; and all of them in time appear to lose insensibly their tone and proper action.

Ivory Hygroscope.

An attempt was lately made by Professor Leslie to revive the method of measuring the expansion of absorbent cohesive substances, by their enlargement of capacity when disposed into a thin shell; and, by successive steps, he carried the hygroscope thus formed to as high a state of improvement as perhaps such an imperfect instrument will admit. A piece of fine grained ivory, about an inch and quarter in length, was turned into an elongated spheroid, as thin as possible, weighing only 8 or 10 grains, but capable of containing, at its greatest expansion, about 300 grains of mercury; and the upper end, which was adapted to the body by means of a delicate screw, had a slender tube inserted, 6 or 8 inches long, and with a bore of nearly the 15th part of an inch in diameter. (See fig. 19, Plate XCVII.) The instrument being now fitted together, its elliptical shell was dipped into distilled water, or lapped round with a wet bit of linen, and after a considerable interval of time, filled with mercury to some convenient point near the bottom of the tube, where is fixed the beginning of the scale. The divisions themselves were ascertained by distinguishing the tube into spaces which correspond each of them to the thousandth part of the entire cavity, and equal to the measure of about three-tenths of a grain of mercury. The ordinary range of the

* From Ὑγρος, *wet*, or *humid*, and μετρον, *a measure*. *Hygrometer* is distinguished from *Hygroscope;* the former *measuring* the humidity of the air, and the latter only vaguely marking its presence.

scale included about 70 of those divisions. To the upper end of the tube was adapted a small ivory cap, which allowed the penetration of air, but prevented the escape of the mercury, and thereby rendered the instrument tolerably portable.

Peculiarity of its Contractions.

This hygroscope was largely, though rather slowly, affected by any change in the humidity of the ambient medium. As the air became drier, it attracted a portion of moisture from the shell or bulb of ivory, which, suffering in consequence a contraction, squeezed its contained mercury so much higher in the tube. But if, on the contrary, the air inclined more to dampness, the thin bulb imbibed moisture and swelled proportionally, allowing the quicksilver to subside towards its enlarged cavity. These variations, however, were very far from corresponding with the real measures of atmospheric dryness or humidity. Near the point of extreme dampness, the alterations of the hygroscope were much augmented; but they diminished rapidly, as the mercury approached the upper part of the scale. The contraction of the ivory answering to an equal rise in the dryness of the air, was found to be six times greater at the beginning of the scale than at the seventieth hygroscopic division; and seemed in general to be inversely as the number of hygrometric degrees, reckoning from 20 below. Mr Leslie placed, therefore, another scale along the opposite side of the tube, the space between the zero and the seventieth division of the hygroscope being distinguished into 100 degrees, and corresponding to the unequal portions from the number 20 to 120 on a logarithmic line. This very singular property will be more easily conceived from the inspection of the figure. The scale might probably be extended farther by continuing the logarithmic divisions. Thus, 320 degrees by the hygrometer would answer to 108 of the hygroscope, or to a contraction of 108 parts in a thousand in the capacity of the bulb. But at the dryness of 300, the contraction of the ivory seemed never to exceed 105.

Boxwood was likewise formed into a hygroscope, of the same shape and dimensions; but this absorbent material swells twice as much with moisture as ivory does, and therefore requires its inserted tube to be proportionally longer or wider. Its contractions are still more unequal than those of ivory. For, near the point of extreme humidity, those alterations in the capacity of the bulb appeared to be more than twenty times greater than, under like changes in the condition of the atmosphere, take place towards the upper part of the scale. The space included between the commencement and the hundred and fortieth millesimal division of the scale, might hence be marked with 100 hygrometric degrees corresponding to the decreasing portions of a logarithmic line from 5 to 105.

In noticing the rapidly declining contractions which ivory and box-wood undergo, Mr Leslie did not mean, however, to state the quantities with rigorous precision. Much time had been consumed in attempting to trace out the law of those gradations; and such experiments are rendered the more tedious, from the protracted action of the hygroscope, which often continues travelling slowly for the space of a quarter or even half an hour. This tardiness is indeed the great defect of all instruments of that nature, and utterly disqualifies them from every sort of delicate observation.

The very large expansions which the hygroscope shows on its approach to extreme humidity, explains in a satisfactory manner the injury which furniture and pieces of cabinet-work sustain from the prevalence of dampness. On the other hand, the slight alteration which the instrument undergoes in a medium of highly dry atmosphere, seems to have led most philosophers to believe that there is an absolute term of dryness, on the distance of which from the point of extreme moisture, they have generally founded the graduation of the different hygroscopes proposed by them. This opinion, however, is far from being correct, and might give occasion to most erroneous conclusions. No bounds can be set to the actual dryness of the air, or the quantity of moisture which it is capable of holding, which, by the joint application of heat and rarefaction, may be pushed to an almost indefinite extent.

The ivory hygroscope, after being for several hours immersed in air remarkably dry, was apt of a sudden to split longitudinally. But if the bulb endured such a range of contraction, it appeared in some instances to take at least *another set*, or to accommodate its constitution, by imperceptible changes, to the state of the surrounding medium.

But though the bulbous hygroscope is, in extreme cases, liable to much uncertainty and some risk, it may yet be used with visible advantage, in certain peculiar situations. The very sluggishness of the instrument, when the value of its divisions has been once ascertained, fits it so much the better for indicating the mean results. After being long exposed in situations hardly accessible, it may be conveniently transported for inspection, before it can suffer any sensible change. The hygroscope could be, therefore, employed with success, to discover the degree of humidity which prevails at considerable elevations in the atmosphere. It might be likewise used, for ascertaining readily the precise condition of various goods and commodities. Thus, if the bulb were introduced, for the space perhaps of half an hour, into a bag of wool, a sack of corn, or a bale of paper, it would, on being withdrawn from their contact, mark the dryness or humidity of those very absorbent substances.

Other hygroscopic substances have at different times been proposed, which, though possessed of greater sensibility, are yet liable to the same general objections. Thus, quills, reeds, gold beaters' skin or pellicle, the skins of frogs, or the bladders of rats, were made to act like the bulbs of thermometers, and to cause, by their contraction or dilatation, as they inclined to dryness or humidity, the included quicksilver to rise or fall in rather a wide tube. These instruments, however, being subject to injury or derangement from the smallest accident, can scarcely be applied to any practical use.

The hygroscopes which depend on the elongation of the fibres are perhaps on the whole preferable. The slice of whalebone proposed by M. Deluc, and the human hair afterwards employed by M. de Saussure, are both of them sufficiently sensible to

external impressions; but the difficulty is to determine the precise relation subsisting between those impressions and the state of the atmosphere. Humidity is not distributed in equal shares through the air and among the several absorbent substances exposed to its penetration; nor are the degrees of expansion which it communicates either uniform or proportional to its quantity. The graduation of such instruments, being thus in a great measure arbitrary, can furnish no correct data of the hygrometric state of the atmosphere. The assumption of two fixed extreme points as the basis of the scale is evidently erroneous. Air contained within a glass receiver may be rendered as damp as possible, by the copious aspersion of water on the sides; but it can never be absolutely deprived of its moisture, which adheres the more powerfully in proportion as it becomes diminished. Caustic alkalis, concentrated acids, and some of the deliquescent salts, aided by the action of heat, all render the air drier, but without being able to complete the desiccation. By the combined application of other agents, and even by mechanical pressure, the driest air can always be made to deposit some farther portion of moisture.

M. de Saussure directed all the resources of his ingenuity to correct the anomalies of the instrument which he proposed, and at last succeeded, by multiplied precautions, in rendering it as perfect, perhaps, as its nature and composition will admit. The hair-hygroscope (for it is not entitled to the name of hygrometer) certainly shows mobility; but the degrees which it marks can afford no steady or tolerably correct estimate of the dryness of the atmosphere.*

Expansion Hygrometer.

To arrive at an accurate measure of the dryness of the air, it is necessary to pursue a different route. Steam, in whatever way it be formed, whether by the application of heat, or the diminution of atmospheric pressure, has nearly the double of the elasticity of common air, or it would, under the same compressing force, occupy about twice as much space. In uniting with that fluid, and forming vapour, it must hence communicate an expansion exactly proportional to the quantity dissolved, or to the share of moisture required for the complete saturation of the air. This principle suggested to Mr Leslie the means of constructing an accurate hygrometer, to which his researches had been early directed. Inverting a barrel-tumbler, he ground the mouth perfectly flat, and having drilled a hole through the bottom, he cemented into it a syphon-gage, or slender recurved tube, with a narrow bore, and an intermediate swell or cavity, passing through a perforated cap of lead, and holding a portion of nut oil, tinged with alkanet root. (See Fig. 6, Plate XCVI., where it is represented half the natural size.) To form the scale, he divided 4.2 inches into an hundred equal parts; so that each degree corresponded to the ten thousandth part of the air's elasticity, the whole atmospheric pressure being equal to that of a column of the oil 420 inches in height. Having now spread a few drops of water over a surface of plate glass, and slipped the tumbler upon it, the included air quickly dissolved as much moisture as was sufficient for its saturation, and marked the expansion thence acquired, by forcing the oil to rise proportionally. The quantity of effect varied much, but was often very considerable, amounting, in fine weather, to 110 or 120 degrees. This little apparatus appeared to answer the purpose intended, but it was not portable, and it always required some address. It soon gave way, therefore, to other instruments, which promised to be more easily and readily managed.

As an hygrometer of this kind exhibits the actual expansion or increase of elasticity, which the air acquires from complete humifaction, it seemed calculated for indicating the variable power of a drier or a moister atmosphere in refracting the rays of light. The barometer and thermometer had long been employed to correct the quantity of refraction; but the application of an accurate hygrometer seemed no less necessary for delicate observations. An instrument of the composition now described was accordingly entrusted, in the course of the year 1794, to the late Dr Maskelyne, and deposited in the Royal Observatory of Greenwich. Other objects, however, interfered, and an investigation, which promised important results, was never prosecuted on a regular and digested plan.

Its Compound Form.

This instrument might be rendered still more accurate, by combining it with the principle of the differential thermometer. Let two similar tumblers (see fig. 5, Plate XCVI., where it is contracted to about the fourth part of its size), A and B, inverted and loaded, have their mouths ground to fit a glass plate, the air contained in each of them acting by its elasticity on the column of a recurved tube, C, which connects their cavities. Slide both of these tumblers in a dry state upon their bases, dip a hair-pencil in oil, and pass it round the outside of the mouth of A, to make it quite tight; then having removed B, and spread a few drops of water over its place, slip it on the plate again. The air included in B, now absorbing moisture, will continue to expand and to press upon the liquid column, till it has become absolutely saturated. Should any change take place in the temperature of the room during this process, it can have no effect in deranging the indication of the instrument, since it must influence precisely in the same degree the elasticity of the air contained in both balls, and thus produce an exact counter-balance.

Mode of ascertaining alterations of Bulk.

This compound instrument is adapted to various delicate physical inquiries. In the union of different substances, a certain alteration of volume, however minute, almost invariably takes place. To ascertain such changes under various circumstances greatly ex-

* From the few observations which we have yet had time to make with an instrument of this kind recently brought from Geneva, we are sorry to say, that it falls much below our expectations. Its motions are slow and irregular; and it seems to be little affected by very considerable alterations of the state of the encircling medium.

tends our views of the empire of chemical affinity. For instance, a small bit of fresh charcoal introduced under one of the tumblers will mark its absorption of the air, by the consequent rising of the coloured liquid. But the tumbler being wetted over the inside, and a portion of dry, though not recent, charcoal, with a pared surface, placed within it, after the air has ceased to dilate from humifaction, if the charcoal be brought in contact with water, the liquor will again rise, and continue for some time to indicate a renewed expansion. As the water is imbibed by the charcoal, minute globules of air will appear to escape. But if the water, by its insinuation, had merely dislodged the air from the pores, there would have been no change of volume, and consequently no alteration in the height of the liquid on the scale. Those aërial globules must have, therefore, expanded as they emerged, or they had existed in a state of condensation united to the charcoal.

On the other hand, if a roll of unsized paper, linen rags, slips of wood, or saw-dust, be successively introduced under a tumbler in which a little water is easily shed, the coloured liquor will sink rapidly in proportion as the moisture is absorbed. In this case, there is an obvious diminution of volume, and an union produced between a liquid and a solid, quite analogous to chemical solution; whereas capillary action, such as the ascent of water through sand, is attended by no change whatever of the space occupied by the compound.

Another application of this instrument was to place under the tumbler separate capsules containing different substances, liquid or solid, which exert a mutual attraction. The included air in this case served as the vehicle of transfer, and a sort of distillation was supported, of a peculiar kind. The indications of this invisible process were variable, and often striking. But to enlarge on this subject would be foreign to our purpose. We have only taken the opportunity of noting a few of the results of an inquiry which was not pushed to any extent, but which deserves to be resumed, as likely to open new paths, and to unfold the more abstruse relations subsisting among different bodies.

Confused ideas of the Process of Evaporation.

Philosophers have long entertained very crude notions respecting the union of moisture with air, and the different circumstances which regulate or influence the process of evaporation. Dr Halley supposed that fire, uniting with the particles of water, communicates a vesicular constitution, which enables them to rise and spread through the atmosphere. A similar idea was entertained by Leibnitz, and was extended still farther by Musschenbroek and Desaguliers. Kratzenstein adopted the vesicular system in 1743, and endeavoured to calculate the attenuation of the fluid which should produce the requisite buoyancy. Hamberger, in 1750, advanced, however, a capital step, by rejecting that hypothesis entirely, and attributing evaporation at once to a real solution of moisture in the air. This simple theory was in the following year explained at large by Le Roi of Montpellier, and fortified by some striking arguments drawn chiefly from analogy. In pursuance of his theory, he proposed to pour ice-cold water into a deep glass, and to ascertain the dryness of the air, by noting the depressed temperature at which the dewing or deposition of vapour began to form on the outside of the glass, or was again about to disappear. Could this method have been easily and nicely reduced to practice, it might certainly have furnished an accurate estimate of the hygrometer and state of the atmosphere.

Wallerius, in his researches, was drawn aside from the right path, by a fact first noticed by Musschenbroek, who asserted that evaporation is always more copious from a deep than from a shallow vessel; and this curious and apparently anomalous fact has been confirmed by other subsequent experiments. But he found from a series of careful observations, that the quantity of water exhaled in the same situation is exactly proportional to the extent of surface exposed. He likewise made some experiments which seemed to furnish an explication of the peculiarity remarked by Musschenbroek, though their force was not generally perceived at the time. But Richman rather darkened the subject by his strange conclusion, that the measure of evaporation depends on the difference merely between the temperature of the air and of the water, whether in excess or defect.

It was not difficult to perceive that evaporation is promoted by the application of heat, and the agitation of the aërial medium. No attempts, however, were made to determine the relation of that augmented effect to the actual velocity of the wind. But experiments on the influence which an increase of temperature exerts on the quantity of evaporation have been prosecuted with various success, by Lambert, Saussure, and Kirwan. The results thus obtained unfortunately differ very widely; and though the researches of the celebrated Naturalist of Geneva were those conducted with the most care and address, yet they seem, from the vagueness of their elements, not entitled to much confidence.

Vague explication of the Cold produced it.

If the estimate of the causes which regulate the quantity of evaporation was unsatisfactory, still more perplexing appeared the ordinary account of the source of that depression of temperature which always accompanies the process. It was commonly referred to the operation of different concurring circumstances, among which the agitation of the air was conceived to perform the principal part. The dryness of that medium, on which we shall find the effect alone to depend, was in a great measure overlooked, or was confounded with other occasional agents. An evident confusion of ideas prevailed. The celerity of evaporation was mistaken for its intensity, and the coldness induced on the exhaling surface was viewed as the accumulated effect of a rapid dissipation of moisture. It was not perceived that in a free atmosphere, vaporization proceeds with unabated energy, while the corresponding depression of temperature must advance by a relaxing progression, since otherwise the accession of an accelerated movement might push it to any extent. A little reflection, indeed, should have convinced philosophers, that the reduced temperature caused by vaporization must, in given circumstances, have a certain limit beyond which it cannot pass. But simple as this conclusion may now appear, it had escaped the most sagacious inquirers. Even Saus-

sure, a patient and accurate experimenter, persuaded himself that, when water evaporates slowly, the cold produced is scarcely perceptible. To render this sensible, therefore, he thought it necessary to accelerate evaporation. Inserting the ball of a thermometer in a wet sponge, and attaching a cord to its stem, he whirled it briskly round his head, and thus produced a cold of 18 degrees by Fahrenheit's scale, which he considered as much greater than could be obtained by other processes. To prosecute the inquiry, he had a sort of whirling table constructed, of about five feet diameter, by means of which a thermometer with its bulb incased in wet sponge, could be made to revolve with the velocity of 40 feet in a second. This machine he was at the trouble and expence of having carried up to the summit of the Col-du-Geant, where, during a residence of several days, he performed a series of interesting and valuable experiments. It did not occur to this philosopher, that by such a contrivance he was only creating to himself a vast deal of unnecessary fatigue, and that his wet thermometer, if left simply at rest for the space of two or three minutes, would have indicated exactly the same results. By all his exertions, he merely shortened the very moderate time required for attaining its extreme limit of depression.

Such were the imperfect notions which still prevailed on the subject of evaporation, so late as the year 1796, the date of the publication of the last volume of the *Voyages dans les Alpes*. It is curious to remark, that Dr Black, in his Lectures, never mentions the dryness of the air as any way promoting evaporation, but ascribes the acceleration of the process entirely to the warmth and agitation of that medium. His friend, Dr James Hutton, whose acuteness and penetration were conspicuous, had probably studied the phenomenon more closely. " I never had a hygrometer," he says ; " but I used to amuse myself in walking in the fields, by observing the temperature of the air with the thermometer, and trying its dryness by the evaporation of water. The method I pursued was this: I had a thermometer included within a glass tube, hermetically sealed ; this I held in a proper situation until it acquired the temperature of the atmosphere, and then I dipped it into a little water also cooled to the same temperature I then exposed my thermometer, with its glass case wetted to a current of air ; and I examined how much the evaporation of the atmosphere, by holding the ball of the thermometer, or the end of the tube in which the ball was inclosed towards the current of air ; and I examined how much the evaporation from that glass tube cooled the ball of the thermometer which was included." He then proceeds to relate some hasty and very inaccurate observations made in this way. The passage now quoted occurs in a quarto volume, published in 1792, buried in a repulsive mass of diffuse reasoning and paradoxical speculation, unsupported by any definite experiment. But Dr Hutton had evidently considered it as a conjectural hint on which he laid little stress ; for he speaks immediately afterwards of our possessing accurate hygrometers, which could not be admitted if the assumption he seemed to make had been strictly true.

While such loose and imperfect notions prevailed respecting evaporation, it was expedient to review the process with attention, and analyse the several changes which accompany it. The depression of temperature which it always occasions had been hastily supposed to be proportional to the rate with which the moisture is dissipated, and to be therefore augmented by every circumstance that can accelerate this effect. But if water contained in a porous vessel expose on all sides its surface to a current of air, it will cool down to a certain point, and there its temperature will remain stationary. The rapidity of the current must no doubt hasten the term of equilibrium, but the degree of cold thus induced will be found still the same. A little reflection may discover how this takes place. It is well known that the conversion of water into steam is, in every case, attended by the absorption of the heat requisite to support a gaseous constitution. Though the humid surface has now ceased to grow colder, the dispersion of invisible vapour, and the corresponding abstraction of heat, still continue without intermission. The same medium, therefore, which transports the vapour, must also furnish the portion of heat required for its incessant formation. In fact, after the water has been once cooled down, each portion of the ambient air which comes to touch the evaporating surface must, from its contact with a substance so greatly denser than itself, be likewise cooled down to the same standard, and must hence communicate to the liquid its surplus heat, or the difference between the prior and the subsequent state of the solvent, which is proportioned to the diminution of temperature it has suffered. Every shell of air that in succession encircles the humid mass, while it absorbs, along with the moisture which it dissolves, the measure of heat to convert this into steam does at the same instant thus deposite an equal measure of its own heat, on the chill exhaling surface. The abstraction of heat by vaporization on the one hand, and its deposition on the other, at the surface of contact, are, therefore, opposite contemporaneous acts, which soon produce a mutual balance, and thereafter the resulting temperature continues without the smallest alteration. A rapid circulation of the evaporating medium may quicken the operation of those causes ; but so long as it possesses the same drying quality, it cannot in any degree derange the resulting temperature. The heat deposited by the air on the humid surface becomes thus an accurate measure of the heat spent in vaporizing the portion of moisture required for the saturation of that solvent at its lowered temperature. The dryness of the air is, therefore, under all circumstances, precisely indicated, by the depression of temperature produced on a humid surface which has been exposed freely to its action.

Meteorology.

Analysis of the Operation.

It may insure perspicuity, however, to recapitulate the great principle on which the formation of the hygrometer depends.—When water passes into steam or vapour, it enlarges its capacity, and absorbs a very large share of heat. Any body, therefore, having a wet surface, becomes generally colder, if exposed to the access of air. But this decrease of temperature soon attains a certain limit, where it continues stationary, though the dissipation of moisture still pro-

ceeds with undiminished activity. The same medium which transports the vapour must hence furnish also the portion of heat required for its incessant formation. In fact, after the humid surface has been cooled, each portion of the ambient air which comes to touch it, must likewise be cooled down to the level of the dense substratum. The addition of heat at the surface of contact is thus a contemporaneous act with its subtraction by the process of vaporization; and it quickly advances to the same degree of intensity, after which a mutual balance of opposite effects is maintained, and the coldness hence induced continues unaltered. An augmented circulation of the evaporating medium may hasten the process; but while it has the same drying quality, it cannot in the least affect the depression of temperature. As soon as such an equilibrium is attained, the deposition of heat on the humid surface must become just equal to its abstraction. But this deposition is evidently proportional to the diminution of temperature, which is hence a measure of the share of heat abstracted, and therefore of the dryness of the air, or its distance from saturation.

Confirmed by Experiment.

This analysis of the process of evaporation appears so conclusive, as to banish all doubt and objection. But it was desirable to confirm the deductions of theory by an appeal to direct observation. Accordingly, on setting the hygrometer upon a table in the middle of a room, and blowing from some distance against the wet ball with a pair of bellows, which had acquired the temperature of the apartment, the instrument still indicated the same measure of dryness. The experiment was repeated more accurately on a larger scale, by exposing the hygrometer out of doors to the action of a strong and arid wind, a small screen being interposed and again removed, at short intervals of time, during which alternations no change whatever could be perceived in the quantity of the depression of temperature.

Having, therefore, ascertained the great law of evaporation, and proved that the coldness occasioned by it is not, in any degree, affected by agitation or other extraneous influence, nothing seemed wanting to construct an *Hygrometer* on just principles, but to contrive a thermometer that should mark the smallest alterations of temperature. At first Mr Leslie employed a very delicate thermometer with a short range, open at the top, where a small cap of glass or ivory was fixed, containing a small portion of surplus quicksilver. (See fig. 16 and 17, Plate XCVI.) When this thermometer was heated by the hand, till the thread of quicksilver filled the whole of the stem, and formed a little globule at the top; it was inverted as in fig. 17, and all the quicksilver united into one mass; but when it was restored, as in fig. 18, to its first position, the quicksilver fell back from the cap, and lodged about the end of the stem, leaving the bore completely filled. A cap (see fig. 1, Plate XCVI.) made of thin porous earthen-ware, nearly of the shape of a lady's thimble, but somewhat larger, and filled with water, was exposed to the air, while the thermometer lay beside it in a horizontal position. After a few minutes, the thermometer was lifted up and plunged vertically into the cup; and the thread of quicksilver, which had extended through the whole length of the bore, being, by this change of position, cut off at the top of the tube, immediately contracted, and marked, by the space of its descent, the diminution of temperature in the liquid.

Leslie's Hygrometer.

The very severe winter of 1794-5 afforded Mr Leslie an opportunity of making experiments on the evaporation of ice; in the course of which, he was led to the construction of the differential thermometer, now so generally known. At first he employed it merely as an hygrometer, the one ball being always naked, and the other covered with cambric, wetted as often as occasion required. These balls were about an inch and a half in diameter, and blown to the ends of the same tube, one of them having a projecting point or aperture, which was sealed, after the branches had been bent and a portion of coloured oil introduced. The graduation of the scale was determined, by placing the instrument erect between two boxes, each containing a body of water, which encompassed one of the balls, and by noticing the rise of the oil on changing the relative temperature of the bath. An hygrometer, thus formed, was sent to the late Sir Joseph Banks, in the summer of 1795; and Mr Gilpin, clerk of the Royal Society, deposited a copy of it in their cabinet. But this model is so rude and clumsy, as hardly to recall the original. In the hands of the inventor, however, the instrument was soon improved, and reduced to a convenient and portable size. He had the satisfaction of showing an hygrometer of this construction, in January 1796, to Dr James Hutton, only a few months before the death of that very ingenious philosopher, who was delighted with seeing the application of a principle which he readily comprehended, and which his sagacity had obscurely anticipated.

But the sluggishness of the oil, and its tendency to deposite its colouring matter, on exposure to the influence of light, still opposed obstacles to the perfection of this hygrometer. These were entirely removed, however, about the year 1801, by the substitution of concentrated sulphuric acid, tinged by carmine. The most powerful and continued action of the solar beams was found to produce no change whatever on that purpurine liquid, when precluded from the access of the external air. Any improvements which have since been effected on this instrument consist chiefly in its mechanical arrangement, in the selection of the tubes, the better proportion of the balls, and the elegance and conciseness of the general shape.

Its Construction.

The hygrometer has two distinct forms; the one *portable* and the other *stationary*. The former (see fig. 13, Plate XCVI.) having its balls in the same perpendicular line, is protected by a wooden or metallic case, and fitted for carrying in the pocket; two or three drops of pure water, from the tip of a quill or a hair pencil, being applied to the surface of the covered ball, and the instrument held exactly in a vertical position whenever it is used. The latter form (see fig. 12) is susceptible of rather greater accuracy, having its balls bent opposite ways at the same height. In some instances, it is preferable to retain merely the simplest form of the differential thermometer, the vertical stems being more distant, and the balls not reflected. In both these constructions, the

two balls, since they occupy the same level, cannot be affected in the smallest degree, by the unequal temperatures of the different strata of air in a close heated room. After the covered ball has been wetted, the instrument will continue to perform unimpaired, for the space, perhaps, of two or three hours. The addition of a few drops of water will then restore its action. But the hygrometer may be made to supply itself with moisture. It is only wanted to pass some fibres of floss-silk close over the humid ball, and immerse them at the distance of a few inches in a tall glass decanter, full of water, with a stopper which leaves open a small projecting lip.

The hygrometer has its opposite balls made to exhibit nearly the same colour and opacity, in order to exclude the admixture of photometrical influence, or prevent any derangement which the unequal action of light might otherwise occasion. The naked ball is blown of red, green, or blue glass, and the papered one is externally covered with thin silk, of rather a fainter shade, as it takes a deeper tint when moistened.

Its Theory completed

The theory which we have given of the hygrometer, corroborated by its accurate performance, might appear complete in every part. But the progress of science commonly detects the existence of some collateral causes which come to mingle their influence with the action of the great dominating principles. In our explication of the hygrometer, we stated that the same air which *abstracts* moisture, and consequently the portion of heat necessary to convert it into the gaseous form, must likewise *communicate* to the wet ball another portion of heat equal to its depression of temperature, which is hence maintained at a constant point. This analysis, however, involves the supposition that the air conveys heat from bodies, merely by its actual transfer. But having discovered that air transmits a certain share, at least, of the heat by a sort of pulsation, or internal tremor, depending on the quality of the surface from which the impression originates; it was requisite to examine anew the process of evaporation. The effect cannot be produced solely, by the quickened recession of the contiguous portions of the ambient medium. The conterminous air must communicate heat to the humid surface also by pulsation; and hence the balance of temperature would be liable to incidental variations, if moisture, with its embodied heat, were not likewise abstracted by some corresponding process. And such is the harmonious adaptation of these elements: The discharge of vapour appears to be subject precisely to the same conditions as the emission of heat, and in both cases the proximity of a vitreous or a metallic surface produces effects which are entirely similar. Let two pieces of thin mirror-glass, or what is called Dutch plate, be selected, about four inches and a half square; and having applied a smooth coat of tinfoil, four inches square, to one of these, cover them both with a layer of the thinnest goldbeater's skin, which will adhere closely on being wetted; and after it has again become dry, cut it on each into an exact square of four inches and a quarter: Now place the two glass plates horizontally in the opposite scales of a fine balance, and adjust them to an exact counterpoise: then, with a hair pencil, spread two grains of water over the surface of each pellicle: in a few seconds, the plate which is coated with tinfoil will preponderate, and after the former has lost all its moisture, this will be found to retain still three-tenths of a grain. The proximity of the subjacent metal to the humid surface, therefore, impedes the process of evaporation, in the ratio of 17 to 20; the very same as, in like circumstances, had been ascertained to be the retardation of the efflux of heat. From this and other experiments, we learn, that some constant portion from a humid surface is always abstracted by the pulsation of the aërial medium. The steam exhaled, in uniting with the air, communicates to this elastic fluid a sudden dilatation, which will continue to propagate itself in successive waves.

In farther illustration of this matter, cover with a thin pellicle of goldbeater's skin, both the balls of the *pyroscope*, or that form of the differential thermometer which has one ball naked, and the other enamelled with gold or silver, and wet them equally. The coloured liquid will remain for several minutes stationary at the beginning of the scale, and will then mount slowly, perhaps 10 or 15 degrees. Evaporation had, therefore, produced the same cold or depression of temperature upon the surface of the metal as upon that of the glass; from the glass, however, it was more copious than from the metal, having left the former dry, while the latter still exhaled some portion of moisture. But this action soon ceased, and the liquid fell back to its former level. On applying another pellicle, the liquid continued longer stationary, and rose only about five degrees. With repeated pellicles a difference was perceptible in the time of drying the two balls, till the thickness amounted to the 600th part of an inch.

The Mode of Graduating it.

The method employed for the graduation of the hygrometer is not only very convenient, but susceptible of great accuracy. The instrument, with a temporary scale affixed to it, is introduced into a magazine of dry air, and compared with a standard then put in action. To procure the dryness of the included medium, a flat saucer of thirteen inches in diameter, and holding a body, about half an inch deep, of concentrated sulphuric acid, and set on a ground plate of glass or metal, is covered by a very large inverted receiver, containing more than 1500 cubic inches of air, and having at the top an opening of three inches wide, on which rests a smaller plate, with two or three hooks projecting down from it. The scale of the standard instrument was determined, by suspending beside it under the receiver two delicate thermometers, one of which had its bulb coated with several folds of wet tissue paper. The descent of the coloured liquid of the hygrometer, corresponding to the difference of ten centesimal degrees of the parallel thermometers, was hence computed, and this length afterwards divided into an hundred equal parts, to form the standard degrees. To graduate any other instrument, it was only requisite to attach a scale of inches, and mark the simultaneous measures, when a steady equilibrium had at last obtained. The space of half an hour is generally sufficient to bring this about. A simple pro-

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Meteorology.

portion, therefore, discovers the length answering to an hundred millesimal degrees, from which the sublivisions of each particular scale are derived.

The condition of the atmosphere with respect to dryness is extremely variable. In our climate, the hygrometer will, during winter, mark from 5 to 25 degrees; but, in the summer months, it will generally range between 15 and 55 degrees, and may even rise, on some particular days, as high as 80 or 90 degrees. On the continent of Europe, it maintains a much greater elevation; and in Upper India it has frequently stood at 160 degrees.

When the indication of the hygrometer does not exceed 15 degrees, we are directed by our feelings to call the air damp; from 30 to 40 degrees we begin to reckon it dry; from 50 to 60 degrees we should account it very dry; and from 70 degrees upwards, we might consider it as intensely dry. A room is not comfortable, or perhaps wholesome, if it has less than 30 degrees of dryness; but the atmosphere of a warm occupied apartment will commonly produce an effect of upwards of 50 degrees.

Its Performance during Frost.

But this hygrometer will perform its office even if it be exposed to frost. The moisture spreads over the surface, and imbibed into the coat of the papered ball, will first cool a few degrees below the freezing point, and then congeal quickly into a solid compound mass. The moment in which congelation begins, a portion of heat liberated in that act brings the ball back to the temperature of freezing, and the coloured liquor, in proportion to the coldness of the external air, starts up in the opposite stem, where it remains at the same height, till the process of consolidation is completed. After the icy crust has been formed, evaporation again goes regularly forward; and if new portions of water be applied, the ice will, from the union of those repeated films, acquire a thickness sufficient to last for several days. The temperature of the frozen coat becomes lowered in proportion to the dryness of the atmosphere. The measure of heat deposited on the chill surface by the contact of the ambient air is then counterbalanced by the two distinct, though conjoined measures of heat, abstracted in the successive acts of converting the exterior film of ice into water, and this water into steam; which transformations that minute portion must undergo, before it can unite with its gaseous solvent But the heat required for the melting of ice being about the seventh part of what is consumed in the vaporization of water, it follows that the hygrometer, when the surface of its sentient ball has become frozen, will, in like circumstances, sink more than before by one degree in seven. This inference is entirely confirmed by observation. Suppose, in frosty weather, the hygrometer, placed on the outside of the window, to stand at 28 degrees; it may continue for some considerable time at that point, until the congelation of its humidity commences: but after this change has been effected, and the equilibrium again restored, the instrument will now mark 32 degrees.

Estimate of the Hygrometric Degrees.

The theory of this hygrometer will enable us to determine not only the relative, but even the absolute dryness of the air, or the quantity of moisture which it can absorb, by comparing the capacity of that solvent with the measure of heat required to convert a given portion of water into steam. To discover the capacity of air is, however, a problem of great difficulty, and it has not, perhaps, even yet been ascertained with much precision. It was formerly estimated, we are convinced, by far too high. Thus, Dr Crawford made it to be 1.85 times, or nearly double that of water. But from several concurring observations, we should reckon the capacity of air to be only three-tenth parts of that of water. But 600 centesimal degrees, or 6000 on the millesimal scale, being consumed in the vaporization of water, this measure of heat would prove sufficient to raise an equal mass of air 20,000 millesimal degrees, or those 6000 degrees augmented in the ratio of 10 to 3. Now, at the state of equilibrium, the quantity of heat that each portion of the aërial medium deposites in touching the chill exhaling surface, or what answers to the depression of temperature which it suffers from this contact, must, as we have seen, be exactly equal to the opposite measure of heat abstracted by it in dissolving its corresponding share of moisture. Wherefore, at the temperature of the wet ball, atmospheric air would take up moisture amounting to the 20,000th part of its weight, for each degree marked by the hygrometer. Thus, supposing the hygrometer to mark 50 degrees, the air would then require humidity equal to the 320th part of its weight for saturation at its reduced temperature. When the papered ball of the hygrometer is frozen, the degrees of this instrument must have their value increased by one-seventh, so that each of them will now correspond to an absorption of moisture equal to the 17,000th part of the weight of the air.

But the value of those degrees becomes augmented in a much higher proportion, if the hygrometer be immersed in hydrogen gas. This very dilute medium appears to have about eight times the capacity of common air, and the quantity of heat which, under similar circumstances, it will deposite on the evaporating surface, must likewise, from the same principle of mutual balance, be eight times greater, and consequently, each hygrometric degree will indicate an absorption of moisture equal in weight to the 750th part of the solvent. The energy of hydrogen gas is therefore scarcely less remarkable in dissolving moisture than in containing heat. Confined with a powerful absorbent substance, while common air marks 80 degrees of dryness, hydrogen gas will indicate 70. This gas must, in similar circumstances, therefore, hold in solution seven times as much moisture as the atmospheric medium.

Law of Atmosphere.

To discover the precise law by which equal additions of heat augment the dryness of air or its power to retain moisture, is a problem of great delicacy and importance. Two different modes were employed in that investigation, but which led to the same results. The one was, in a large close room, to bring an hygrometer, conjoined with a thermometer, successively near to a stove intensely heated, and to note the simultaneous indications of both instruments; or to employ two nice thermometers, placed beside each other, and having their bulbs covered respectively with dry and with wet cambric. By taking the mean of numerous observations, and inter-

polating the intermediate quantities, the law of aqueous solution in air was laboriously traced. But the other method of investigation appeared better adapted for the higher temperatures. A thin hollow ball of tin, four inches in diameter, and having a very small neck, was neatly covered with linen; and, being filled with water nearly boiling, and a thermometer inserted, it was hung likewise in a spacious close room, and the rate of its cooling carefully marked. The experiment was next repeated, by suspending it to the end of a fine beam, and wetting with a hair pencil the surface of the linen, till brought in exact equipoise to some given weight in the opposite scale; ten grains being now taken out, the humid ball was allowed to rest against the point of a tapered glass tube, and the interval of time, with the corresponding diminution of temperature, observed, when it rose again to the position of equilibrium. The same operation was successively renewed; but, as the rapidity of the evaporation declined, five, and afterwards two, grains only were, at each trial, withdrawn from the scale. From such a series of facts, it was easy to estimate the quantities of moisture which the same air will dissolve at different temperatures, and also the corresponding measures of heat expended in the process of solution.

By connecting the range of observations, it would appear, that air has its dryness doubled at each rise of temperature, answering to 15 centesimal degrees. Thus, at the freezing point, air is capable of holding a portion of moisture represented by 100 degrees of the hygrometer; at the temperature of 15 centigrade, it could contain 200 such parts; at that of 30, it might dissolve 400; and, at 45 on the same scale, 800. Or, if we reckon by Fahrenheit's divisions, air absolutely humid holds, at the limit of congelation, the hundred and sixtieth part of its weight of moisture; at the temperature of 59 degrees, the eightieth part; at that of 86 degrees, the fortieth part; at that of 113 degrees, the twentieth part; and at that of 140 degrees, the tenth part. While the temperature, therefore, advances uniformly in arithmetical progression, the dissolving power which this communicates to the air, mounts with the accelerating rapidity of a geometrical series.

Temperature of Saturation.

It hence follows, that, whatever be the actual condition of a mass of air, there must always exist some temperature at which it would become perfectly damp, as M. Leroi had first advanced. Nor is it difficult, from what has been already stated, to determine this *dewing point* in any given case. Thus, suppose the hygrometer to mark 52, while its wet ball has a temperature of 20 centesimal degrees or 68 by Fahrenheit; the dissolving power of air at this temperature being 252, its distance from absolute humidity will therefore be 200, which is the measure of solution answering to 15 centesimal degrees or 59 by Fahrenheit. The same air would consequently, at the depressed temperature of 59 degrees, shrink into a state of absolute saturation; and if cooled lower, it would even deposite a portion of its combined moisture, losing the eightieth part of its weight at the verge of freezing.

Annexed is a small table of the solvent power of air, from the temperature of 15 centesimal degrees below zero to 44 above it, or from −5° of Fahrenheit's scale to 111°.2.

QUANTITIES of MOISTURE dissolved in Atmospheric Air at different Temperatures by the Centesimal Scale.

Temp.	Moist.	Temp.	Moist.	Temp.	Moist.	Temp.	Moist.
°		°		°		°	
−15	50.0	0	100.0	15	200.0	30	400.0
−14	52.4	1	104.7	16	209.5	31	418.9
−13	54.9	2	109.7	17	219.4	32	438.7
−12	57.4	3	114.9	18	229.7	33	459.5
−11	60 1	4	120.3	19	240.6	34	481.2
−10	63.0	5	126.0	20	252.0	35	504.0
− 9	66.0	6	132.0	21	263.9	36	527.8
− 8	69.1	7	138.2	22	276.4	37	552.8
− 7	72.4	8	144.7	23	289.5	38	578.9
− 6	75.8	9	151.6	24	303.1	39	606.3
− 5	79.4	10	158.7	25	317.5	40	635.0
− 4	83.1	11	166.2	26	332.5	41	665.0
− 3	87.1	12	174.1	27	348.2	42	696.4
− 2	91.2	13	182.3	28	364.7	43	729.4
− 1	95.5	14	191.0	29	381.9	44	763.9

These temperatures, and the corresponding quantities of moisture dissolved, may be represented by the abscissæ and ordinates of the logarithmic curve, as in fig. 8, Plate XCVII., where some of the principal terms are marked.

The influence of warmth in augmenting the dryness of the air, or its disposition to absorb moisture, affords also the most satisfactory explication of the singular fact already noticed. If two equal surfaces of water be exposed in the same situation, the one in a shallow, and the other in a deep vessel of metal or porcelain; the latter is always found, after a certain interval of time, to have suffered contrary to what we might expect, more waste by evaporation than the former. Amidst all the changes that happen in the condition of the ambient medium, the shallow pan must necessarily receive more completely than the deeper vessel, the chilling impressions of evaporation, since it exposes a smaller extent of dry surface to be partly heated up again by the contact of the air. The larger mass being, therefore, kept invariably warmer than the other, must in consequence support a more copious exhalation.

Correction of the Hygrometer.

From the principles which have been explained, it likewise results that the hygrometer does not indicate the actual dryness of the air, but only the dryness which it retains, after being reduced to the temperature of the humid ball. The real condition of the medium, however, could easily be determined, from the gradations already ascertained in the power of solution. Suppose, for example, that the hygrometer should mark 42 degrees, while the thermometer stands at 16 centigrade; the moist surface has therefore the temperature of 11.8 centigrade, at which the dissolving energy is less by 37 degrees than at 16 centigrade; and hence the total dryness of the air, at its former temperature, amounted to 79 degrees. The following table will greatly facilitate such reductions. It is computed for as wide a range of dryness and temperature as will probably occur in any climate.

Correction of the Hygrometer, and Position of the Point of Saturation at Different Centesimal Temperatures.

	−15°		−14°		−13°		−12°		−11°		
Hyg.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Hyg.
10	12	−21.0	12	−19.5	12	−18.3	13	−17.8	13	−16.3	10
20	24	−29.2	24	−27.6	25	−26.1	25	−24.7	25	−23.2	20
30	36	−42.7	36	−39.8	37	−37.2	37	−35.0	38	−32.9	30
	−10°		−9°		−8°		−7°		−6°		
10	13	−15.0	13	−13.8	13	−12.5	13	−11.4	13	−10.0	10
20	26	−21.5	26	−19.8	26	−18.2	26	−16.8	27	−15.4	20
30	38	−30.1	39	−28.3	39	−26.1	39	−24.4	40	−22.2	30
	−5°		−4°		−3°		−2°		−1°		
10	14	−9.3	14	−7.9	14	−6.8	14	−5.6	14	−4.5	10
20	27	−14.0	27	−12.6	28	−11.3	28	−9.9	28	−8.6	20
30	40	−20.3	41	−18.8	41	−16.9	42	−15.2	42	−13.7	30
40	53	−29.2	54	−26.9	55	−24.6	55	−22.2	56	−20.4	40
	0°		1°		2°		3°		4°		
10	15	−3.4	15	−2.3	15	−1.2	15	0.0	15	1.0	10
20	29	−7.4	29	−6.1	30	−1.8	30	−3.6	31	−2.3	20
30	43	−12.2	43	−10.6	44	−9.1	45	−7.7	45	−6.3	30
40	57	−18.2	58	−16.3	59	−14.5	59	−12.7	60	−11.0	40
	5°		6°		7°		8°		9°		
10	16	2.1	16	3.1	16	4.2	16	5.4	17	6.5	10
20	31	−1.1	32	0.0	32	1.3	33	2.4	33	3.6	20
30	46	−4.9	47	−3.6	48	−2.2	49	−0.9	50	0.4	30
40	61	−9.4	62	−7.8	63	−6.3	64	−1.7	66	−3.3	40
50	76	−15.0	77	−13.0	79	−11.1	80	−9.1	81	−7.6	50
	10°		11°		12°		13°		14°		
10	17	7.5	18	8.6	18	9.6	18	10.7	19	11.8	10
20	34	4.8	35	5.9	35	7.1	36	8.2	37	9.4	20
30	50	1.9	52	3.0	53	4.3	54	5.5	55	6.7	30
40	67	−1.8	68	−0.4	69	1.0	71	2.4	72	3.7	40
50	83	−5.9	84	−4.3	86	−2.7	88	−1.1	89	0.4	50
60	98	−11.0	100	−9.0	102	−7.1	104	−5.4	106	−3.7	60
	15°		16°		17°		18°		19°		
10	19	12.9	20	13.9	20	15.0	20	16.0	21	17.0	10
20	38	10.5	39	11.6	39	12.7	40	13.8	41	14.9	20
30	56	7.9	57	9.1	58	10.3	60	11.5	61	12.7	30
40	74	5.0	75	6.4	77	7.6	79	8.9	81	10.2	40
50	91	1.8	93	3.3	95	4.7	97	6.0	100	7.4	50
60	108	−1.8	111	−0.2	113	1.3	116	2.8	118	4.4	60
70	125	−6.3	128	−4.5	131	−2.6	134	−0.8	136	0.9	70
80	142	−11.8	145	−9.5	148	−7.2	151	−5.2	154	−3.2	80

	20°		21°		22°		23°		24°		
Hyg.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Hyg.
10	21	18.1	22	19.1	22	20.1	23	21.2	24	22.2	10
20	42	16.0	43	17.1	44	18.2	46	19.3	47	20.4	20
30	63	13.8	64	15.0	66	16.1	68	17.3	69	18.4	30
40	83	11.4	84	12.6	87	13.8	89	15.0	91	16.2	40
50	102	8.8	104	10.1	107	11.4	110	12.7	112	13.9	50
60	121	6.1	124	7.4	127	8.7	130	10.2	133	11.5	60
70	140	2.5	143	4.1	146	5.7	150	7.2	154	8.7	70
80	158	–1.3	162	0.5	165	2.3	169	4.0	174	5.6	80
90	176	–5.9	180	–3.8	184	–1.8	188	0.2	193	2.0	90
100	193	–11.5	198	–9.0	202	–6.5	207	–4.3	212	–2.0	100

	25°		26°		27°		28°		29°		
10	24	23.3	25	24.3	26	25.3	26	26.4	27	27.4	10
20	48	21.4	49	22.5	51	23.6	52	24.7	54	25.7	20
30	71	19.5	73	20.6	75	21.7	77	22.8	79	23.9	30
40	94	17.4	96	18.6	99	19.8	102	21.0	104	22.1	40
50	116	15.2	119	16.5	122	17.7	125	18.9	129	20.1	50
60	137	12.8	141	14.1	144	15.4	148	16.7	152	18.1	60
70	158	10.1	162	11.6	166	13.0	171	14.3	175	15.7	70
80	178	7.2	183	8.7	188	10.3	193	11.7	198	13.2	80
90	198	3.9	203	5.6	209	7.2	214	8.9	220	10.4	90
100	218	0.0	223	2.0	229	3.8	235	5.6	241	7.4	100
110	237	–4.5	242	–2.3	249	–0.1	255	2.0	262	3.9	110
120	255	–10.2	261	–7.4	268	–4.8	275	–2.4	282	–0.1	120

	30°		31°		32°		33°		34°		
10	28	28.4	29	29.5	30	30.5	31	31.5	32	32.5	10
20	55	26.8	57	27.8	59	28.9	61	30.0	63	31.0	20
30	82	25.0	84	26.1	87	27.2	90	28.3	92	29.4	30
40	108	23.2	111	24.4	114	25.5	118	26.6	121	27.7	40
50	133	21.3	136	22.5	141	23.7	145	24.9	149	26.0	50
60	157	19.3	161	20.5	166	21.7	171	22.9	177	24.1	60
70	181	17.0	186	18.3	191	19.6	197	20.9	203	22.1	70
80	204	14.6	209	16.0	216	17.4	222	18.7	229	20.0	80
90	226	12.0	233	13.5	239	15.0	246	16.4	254	17.8	90
100	248	9.1	255	10.7	262	12.3	270	13.8	278	15.3	100
110	269	5.8	277	7.6	285	9.3	293	11.0	302	12.6	110
120	290	2.0	298	4.1	307	6.0	316	7.9	325	9.7	120

	35°		36°		37°		38°		39°		
10	33	33.6	34	34.6	35	35.6	36	36.6	37	37.6	10
20	65	32.0	67	33.1	69	34.1	71	35.2	73	36.2	20
30	95	30.5	98	31.5	102	32.6	105	33.7	108	34.7	30
40	125	28.9	129	30.0	133	31.0	138	32.1	142	33.2	40
50	154	27.1	159	28.2	164	29.4	169	30.5	175	31.6	50
60	182	25.3	188	26.5	194	27.7	200	28.8	207	30.0	60
70	209	23.4	216	21.6	223	25.8	230	27.0	238	28.2	70
80	236	21.3	243	22.6	251	23.9	259	25.2	267	26.4	80
90	262	19.2	270	20.5	278	21.9	287	23.2	296	24.5	90
100	287	16.8	295	18.3	305	19.7	314	21.1	324	22.4	100
110	311	14.9	320	15.8	330	17.3	341	18.8	352	20.2	110
120	335	11.4	315	13.1	355	14.7	366	16.3	378	17.9	120
130	358	8.3	368	10.1	380	11.9	391	13.6	404	15.3	130
140	380	4.7	391	6.7	403	8.7	416	10.6	429	12.4	140

	40°		41°		42°		43°		44°		
Hyg.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Dryness.	Point Sat.	Hyg.
10	39	38.6	40	39.7	41	40.7	43	41.7	44	42.7	10
20	76	37.2	79	38.3	81	39.3	84	40.3	87	41.3	20
30	112	35.8	116	36.9	120	37.9	124	39.0	129	40.0	30
40	147	34.3	152	35.4	158	36.5	163	37.6	169	38.7	40
50	181	32.7	187	33.8	194	34.9	201	36.0	208	37.1	50
60	214	31.1	221	32.3	229	33.4	237	34.5	245	35.6	60
70	246	29.4	254	30.6	262	31.8	272	32.9	281	34.1	70
80	276	27.6	286	28.9	295	30.1	305	31.3	316	32.4	80
90	306	25.8	316	27.1	327	28.4	338	29.6	350	30.7	90
100	335	23.7	346	25.1	358	26.4	370	27.7	383	29.0	100
110	363	21.6	375	23.0	388	24.4	401	25.8	414	27.1	110
120	390	19.4	403	20.8	416	22.2	430	23.7	445	25.1	120
130	417	16.9	430	18.5	444	20.0	459	21.5	475	23.0	130
140	443	14.2	457	15.9	472	17.5	487	19.1	504	20.7	140
150	468	11.2	483	13.0	498	14.8	515	16.5	532	18.2	150
160	492	7.8	508	9.8	524	11.8	541	13.7	559	15.5	160

Quantity of Moisture held in the Air.

We may compute that a cubic mass of air 40 inches every way, or a little more than the standard of French measures, and of the ordinary density, weighs 20,000 grains. The table now given exhibits, therefore, in grains, the weight of moisture which a metrical cube of air is capable of holding at different temperatures. Thus, at 20°, which corresponds to 68° of Fahrenheit, this body of air could retain 252 grains of humidity. But if a larger scale be preferred, the same numbers will express, in pounds Troy, the quantity of water required to saturate a perfectly dry mass of air constituting a cube of twenty yards in every dimension.

It is remarkable how small a portion of the aqueous element is at any time suspended in the atmosphere. Reckoning the mean temperature over the surface of the globe to be 19 centesimal degrees, the air could only hold 240.6 parts of humidity for 20,000 times its whole weight; but this weight is nearly the same as that of a column of water of 400 inches in altitude; and hence, if the atmosphere, from a state of absolute dampness, were to pass into that of extreme dryness, and discharge the whole of its watery store, it would form a sheet of 4.812 inches, or somewhat less than 5 inches in depth. To furnish a sufficient supply of rain, the air must therefore undergo very frequent changes from dryness to humidity in the course of the year.

Determined by Experiment.

But it was requisite to subject theory to the test of accurate experiment. For this purpose, a globe or glass balloon was procured, of very large dimensions, containing nearly 4000 cubic inches, terminated by a neck of about three inches wide, having its mouth ground flat. The balloon was supported from the floor by a light circular stand or rim, and a round piece of plate glass perforated through the centre by a hole of about the twentieth part of an inch in diameter, through which passed a slender silver wire suspended from the end of a fine beam placed on the table. This wire was fastened to the top of the scale of a delicate hygrometer, from the lower part of which hung a bit of wet paper nearly three inches in diameter. The whole was balanced by a counterpoise in the opposite scale, so that the instrument occupied the middle of the balloon. As the moisture gradually evaporated from the wet ball of the hygrometer, and still more from the larger surface of the paper attached below it, a loss of weight became visible, while the ascent of the coloured liquid in its tube indicated the corresponding diminution of the dryness of the included air. The progress of humefaction was observed from 50 to 10 degrees of the hygrometer, after each successive grain of water, amounting in all to five, had exhaled and dispersed itself through the medium. Having rectified the hygrometric degrees according to the principle already explained, it was easy to compare them with the weight of the whole mass of air contained within the balloon. The conclusions were, perhaps, as satisfactory as such a nice and fugacious inquiry will admit: and if they be not absolutely correct, they must, at least, approximate very nearly to the truth. It would be superfluous, however, to engage in the details of the experiment, and of the calculations drawn from them; especially as it is intended to repeat the operation under more favourable circumstances, and with every precaution for assisting the equable dispersion of the moisture through the encircling medium.

Modification of the Table.

The table given above is in strictness applicable to air only of the ordinary density. Since this fluid has its capacity for heat enlarged by rarefaction, the same depression of temperature must intimate a proportional augmentation of dryness. Thus, for air at the elevation of three miles and a half, and consequently twice as rare as at the surface, it would be requisite to add the sixteenth part to the numbers in the first column. For the lower altitudes, the correction will be, to multiply those numbers by triple the height in feet, and cut off six decimal places. Thus, suppose, while the thermometer stood at 28 centesimal degrees, that the hygrometer marked 110° on the plains of Mexico, at the elevation of 8000 feet above the level of the sea; then $3 \times 8000 \times 255 = 6120000$, which, being divided by a million, gives 6 to be added to 255, increasing the actual

dryness to 261°. In most cases, therefore, this modification may be neglected.

But, in estimating the distance of the point of saturation in rarefied air, a greater correction will be required. The solvent power of that medium is extended about 50 hygrometric degrees, each time it has its rarefaction doubled. Hence, it may be calculated, that our atmosphere would at the same temperature become a degree drier for every 360 feet of ascent. Thus, on the preceding supposition, the air on the plain of Mexico would have its distance from the point of saturation enlarged $22\frac{1}{2}$ degrees, its whole range being thus $283\frac{1}{2}$ degrees.

Different Applications of the Hygrometer.

If the papered ball of an hygrometer be suffered to become dry, the instrument, even in that state, will mark, though for a short time only, the different condition of the media into which it is transported. Thus, the air of a room being supposed to have 50 degrees of dryness, on carrying the quiescent hygrometer into another apartment of 70 degrees, the column of liquor will fall near 20 degrees, from the renewed evaporation of that portion of moisture which had still adhered to the coats of paper. But if the same instrument were carried into an apartment of only 30 degrees of dryness, the coloured liquor would actually rise near 20 degrees above the beginning of the scale, the paper now attracting the excess of humidity from the air. This vapour, in combining with it, passes into the state of water, and therefore evolves a corresponding share of heat. The equilibrium, however, unless the coats of paper have a considerable thickness, is again restored in a very few minutes.

Those changes are most readily perceived, on immersing the quiescent hygrometer alternately in two receivers containing air drier and damper than that of the room. If a pyroscope, having both its balls covered with goldbeater's skin, be treated in the same way, it will indicate an effect, though momentary indeed, of a similar kind: For, in air which is drier, the pellicle of the naked ball will throw off its moisture more freely than that of the gilt ball; and in damper air it will, on the contrary, imbibe the surplus humidity with greater eagerness; thus losing some portion of heat in the one process, and gaining a minute accession in the other. The quantity of moisture concerned in producing such fleeting alterations may not exceed the thousandth part of a grain.

If a large receiver, having a delicate hygrometer suspended within it, be placed on a brass plate and over a metal cup containing some water; the included air will, from the solution of the moisture, become gradually damper, and this progressive change is marked by the instrument. Yet the mass of air will never reach its term of absolute humidity, and before the hygrometer points at five degrees, the inside of the receiver appears covered with dew. While the humifying process, therefore, still goes on, the close attraction of the glass continually robs the contiguous air of a portion of its moisture; so that, a kind of perpetual distillation is maintained through the aërial medium; the vapour successively formed being again condensed on the vitreous surface. But if, instead of the receiver, there be substituted a vessel formed of polished metal, the confined air will pass through every possible degree of humidity, and the hygrometer will, after some interval, arrive at the beginning of its scale.

The contrasted properties of a vitreous and a metallic surface, in attracting and repelling moisture, may be shown still more easily. In clear, calm weather, let a drinking glass and a silver cup be placed empty near the ground, on the approach of evening; and as the dampness begins to prevail, the glass will become insensibly obscured, and next wetted with profuse dew, before the metal has yet betrayed any traces of humidity. The effect is, indeed, augmented by the cold pulses darted from the sky, which act more powerfully on the glass than on the metal.

Its Practical Utility.

The hygrometer is an instrument of the greatest utility, not only in meteorological observations, but in aiding domestic economy, in regulating many processes of art, and in directing the purchase and selection of various articles of produce. It will detect, for instance, the dampness of an apartment, and discover the condition of a magazine, of an hospital, or of a sick-ward. Most warehouses require to be kept at a certain point of dryness, which is higher or lower according to the purposes for which they are designed. The printing of linen and cotton is carried on in very dry rooms; but the operations of spinning and weaving succeed best in air which rather inclines to dampness. The manufacturer is at present entirely guided by observing the effects produced by stoves, and hence the goods are often shrivelled or otherwise injured before he can discern any alteration in the state of the medium. Wool and corn have their weight augmented sometimes as much as 10 or even 15 *per cent.* by the presence of moisture. But the condition of these commodities could be nicely and readily examined, by heaping them over a small wired cage, within which an hygrometer is placed.

Atmometer.

V. The Atmometer.*—This instrument is an useful auxiliary, and might with some attention serve as a substitute, of the Hygrometer. It does not mark the mere dryness of the air, but it measures the quantity of moisture exhaled from a humid surface in a given time. The atmometer consists of a thin ball of porous earthen-ware, two or three inches in diameter, with a small neck, to which is firmly cemented a long and rather wide glass tube, bearing divisions, each of them corresponding to an internal annular section, equal to a film of liquid that would cover the outer surface of the ball to the thickness of the thousandth part of an inch. (Fig. 8, Plate XCVII.) The divisions are marked by portions of quicksilver introduced, ascertained by a simple calculation, and they are numbered downwards to the extent of 100 to 200; to the top of the tube is fitted a brass cap, having a collar of leather, and which, after the cavity has been filled with distilled water, is screwed tight.

* From Ατμος, *exhalation*, or *vapour*, and μετρον, *a measure*.

The outside of the ball being now wiped dry, the instrument is suspended out of doors, exposed to the free access of the air. In this state of action, the humidity transudes through the porous substance just as fast as it evaporates from the external surface; and this waste is measured by the corresponding descent of the water in the stem.

Quantity of Moisture exhaled.

If the atmometer had its ball perfectly screened from the agitation of wind, its indications would be proportional to the dryness of the air at the lowered temperature of the humid surface; and the quantity of evaporation every hour, as expressed in thousand parts of an inch, would, when multiplied by 20, give the hygrometric measure. For example, in this climate, the mean dryness in winter being reckoned 15°, and in summer 40°, the daily exhalation from a sheltered spot must in winter form a thickness of .018, and amount in summer to .048 decimal parts of an inch. Suppose a pool for the supply of a navigable canal exposed a surface equal to ten English acres, and that the atmometer sank 80 parts during the lapse of 24 hours; the quantity of water exhaled in that time would be $\frac{80}{12000} \times 660 \times 66 \times 10$, or 2904 cubic feet, which corresponds to the weight of 81 tons.

Velocity of Wind.

The dissipation of moisture is much accelerated by the agency of sweeping winds, the effect being sometimes augmented 5 or even 10 times. In general, this augmentation is proportional, as in the case of cooling, to the swiftness of the wind, the action of still air itself being reckoned equal to that produced by a celerity of 8 miles each hour. Hence the velocity of wind is easily computed, from a comparison of the indications of a hygrometer with an atmometer, or of a sheltered, with those of an exposed, atmometer. Thus, suppose the hygrometer to mark 40 degrees, or the column of water in a sheltered atmometer to subside at the rate of 2 divisions every hour, while in one exposed to the current, the descent is 12 divisions; then as 2 is to 10, the superadded effect of the wind, so is 8 to 40 miles, the distance through which it has travelled in that time.

Utility of the Atmometer.

The atmometer is an instrument evidently of extensive application and of great utility in practice. To ascertain with accuracy and readiness the quantity of evaporation from any surface in a given time, is an important acquisition, not only in meteorology, but in agriculture, and the various arts and manufactures. The rate of exhalation from the surface of the ground is scarcely of less consequence than the fall of rain, and a knowledge of it might often direct the farmer advantageously in his operations. On the rapid dispersion of moisture depends the efficacy of drying-houses, which are too frequently constructed most unskilfully, or on very mistaken principles.

It is obvious, that though the atmometer should be exposed to the free air, it must be sheltered from rain, which, by wetting the ball, would derange the proper action of the instrument. This could easily be done, by fixing a small canopy over it; or, in the case of drifting showers, to have a sort of shelved open screen, like Venetian blinds, turned by the wind. The only objection to this atmometer is, that it cannot be used during intense frost, since the expansion of the included water, by a sudden congelation, might burst the ball and even the tube. But the instrument could still be made to act in another way: Let it be emptied, and a certain portion of the water, measured in the stem, be spread over the outside of the ball, by successive layers, to form a coat of ice. The time is to be noted when the whole of this crust has disappeared, or, if any portion should remain, it may be deducted from the whole, and thus the hourly quantity of evaporation ascertained.

Construction of the Photometer.

VI. PHOTOMETER.*—This instrument, which was contrived to indicate the power of illumination, by the slight elevation of temperature which it occasions, has been shortly noticed in the article CLIMATE of this *Supplement*. It consists of a differential thermometer, having one of its balls diaphanous, and the other coated with China ink, or rather blown of deep black enamel. (See fig. 17 and 18, Plate XCVI.) The rays which fall on the clear ball pass through it, without suffering obstruction; but those which strike the dark ball are stopt and absorbed at its surface, where, assuming a latent form, they act as heat. This heat will continue to accumulate, till its farther increase comes to be counterbalanced by an opposite dispersion, caused by the rise of temperature which the ball has come to acquire. At the point of equilibrium, therefore, the constant accessions of heat derived from the action of the incident light, are exactly equalled by the corresponding portions of it again abstracted in the subsequent process of cooling. But, in still air, the rate of cooling is, within moderate limits, proportioned to the excess of the temperature of the heated surface above that of the surrounding medium. Hence the space through which the coloured liquid sinks in the stem, will measure the momentary impressions of light or its actual intensity. To prevent any extraneous agitation of the air from accelerating the discharge of heat from the black ball, and thereby diminishing the quantity of aggregate effect, the instrument is always sheltered, and more especially out of doors, by a thin glass case. The addition of this translucid case is quite indispensable. It not only precludes all irregular action, but maintains, around the sentient part of the instrument, an atmosphere of perpetual calm. Under the same force of incident light, the temperature of the black ball must still rise to the same height above that of its encircling medium. The case will evidently have some influence to confine the heat actually received, and hence to warm up the internal air. Wherefore, corresponding to this excess, the black ball will acquire a farther elevation of temperature; but the clear ball, being immersed in the same fluid, must expe-

Theory of its Operation.

* From φῶς, *light*, and μέτρον, *a measure*.

Meteorology.

rience a similar effect, which will exactly counterbalance the former. The difference of temperature between the opposite balls thus continues unaltered; and neither has the size or the shape of the case, nor the variable state of the exterior atmosphere with respect to rest or agitation, any sensible influence to derange or modify the results exhibited by this delicate instrument.

The photometer has, like the hygrometer, two general forms: The *stationary*, represented by fig. 15, and the *portable*, delineated in fig. 18. But they are both of them easily transported from one place to another. Their glass cases can be screwed off, and the former instrument, being cemented into a small slip of brass, which slides with a spring into the bottom, may be packed separately, if required, while the latter is protected by an external wooden case, in which it is carried in the pocket as safely as a pencil. This case, if screwed below, serves also as a handle to hold the photometer in a vertical position out of doors.

Its Use.

The photometer, placed in open air, exhibits distinctly the progress of illumination from the morning's dawn to the full vigour of noon, and thence its gradual decline till evening has spread her mantle; it marks the growth of light from the winter solstice to the height of summer, and its subsequent decay through the dusky shades of autumn; and it enables us to compare, with numerical accuracy, the brightness of different countries,—the brilliant sky of Italy for instance, with the murky atmosphere of Holland.

In this climate, the direct impression of the sun about midsummer amounts to about 90 degrees; but it regularly declines as his rays become more oblique. The greatest force of the solar beams with us in the depth of winter reaches only to 25 degrees. At the altitude of 17 degrees, it is already reduced to one half; and at 3 degrees above the horizon, the whole effect exceeds not one millesimal degree.

Light of the Sun.

The quantity of indirect light reflected from the sky, though extremely fluctuating in our climate, is often very considerable. It may be estimated at 30 or 40 degrees in summer, and 10 or 15 in winter. This secondary light is most powerful, when the sky is overspread with thin fleecy clouds; it is feeblest, either when the rays are obstructed by a mass of congregated vapours, or when the atmosphere is clear and of a deep azure tint. On the lofty summits of the Alps or Andes, the photometer, screened

Light of the Sky.

from the sun, and only exposed to the dark hue of the broad expanse, would indicate a very small effect. During the late solar eclipse of the 7th of September 1820, the sky being completely overclouded, it showed, both before and after the passage of the moon's disc, only 12 degrees of light; but when the obscuration was the greatest, it marked not more than a single degree.

Various Applications of the Photometer.

The delicacy of this instrument renders it a valuable auxiliary in various scientific inquiries. It ascertains the diminution which the rays of light suffer in reflection, and during their passage through different transparent substances. By combining it with the transferrer of an air-pump, it likewise detects the comparative powers for conducting heat of the several gases, whether in their ordinary state, or when variously attenuated or condensed. Hence we learn, that air expanded 256 times conducts heat nearly twice as slow, or in the ratio of 7 to 13; but that hydrogen gas transfers it with more than redoubled celerity, or in the ratio of 9 to 4. But the photometer will measure also the conducting powers of different liquids. It is only wanted to remove the case, and plunge the instrument erect in a wide metallic vessel, bright on the outside, but blackened within, containing the liquid to be examined, and exposed to the sun's rays. In this way, it was found that water which conveys heat about 30 times faster than air of the mean temperature of our climate, transfuses it with still greater rapidity if warmed to a higher pitch. If the photometer, inclosed within its case, be immersed under the surface of water, the impression of the light will be much stronger than when the balls were encircled by the actual contact of this liquid. Yet will the effect be less than if the case had been surrounded externally by a body of air instead of water, which, by its powerful action in drawing off the accumulated heat, hastens the transmission of it through the internal medium, and reduces the elevation of the temperature of the black ball to nearly one-third part.

From observations made with this instrument, we likewise discover that, in the clearest and most serene sky, one-half only of the sun's light, sloping at an angle of 25°, will reach the ground; and that at an angle of 15°, the proportion is reduced to one-third; but with an obliquity of 5°, the length of track being then extended ten times, one-twentieth part only of the whole incident light can reach the surface. When the sun has approached within a degree of the horizon, and his rays now traverse a track of air equal in weight to a column of about 905 feet of water, no more than the 212th part of them can penetrate to the ground.

The photometer discovers the relative density of different artificial lights, and even contrasts their force of illumination with that of the solar rays. It may be mentioned as a curious inference, that the light emitted from the sun is 12,000 times more powerful than the flame of a wax-candle; or that, if a portion of the luminous solar matter, rather less than an inch in diameter, were transported to our planet, it would throw forth a blaze of light equal to the effect of 12,000 candles.

To compare the illumination of candles or lamps, and of the flame of coal or oil gas, the best form of the photometer, is that of fig. 15, Plate XCVI. guarded both in front and behind by a pair of thin spreading plates of mica, set parallel at the mutual interval of about half an inch. It may be sufficient to notice at present, that the flame of coal gas has more than triple the brilliancy of that of a wax-candle; but a series of experiments on this subject will be soon given to the public.

A photometer of the branched form is easily adapted to measure the diminution which light suffers in penetrating through a body of water. The scale may then be shortened, and the balls enlarged. A bottom of lead is turned to receive the instrument, with its case, which are cemented to it. Thus loaded, the photometer is suspended vertically by cross silk-

Meteorology.

threads, to which a cord of some definite length is attached, terminating by a small bladder. The sky being clear, and the sun shining bright, the instrument is, by help of a long pole, stretched from the side of a boat, held a few minutes suspended about four inches below the surface of the water, and then drawn up, and the number of degrees marked. When the direct action of the solar rays amounted to 90 photometric degrees, their enfeebled influence on the instrument, while thus encompassed externally by a dense chilling body of water, was commonly found to be reduced to 32 degrees. From this point, therefore, the subsequent diminution, occasioned by the descent of the instrument, was computed. The photometer, being let down, was left to float near a quarter of an hour at the depth of perhaps three or six fathoms. On drawing it up, the diminished action of the light, occasioned by the length of oblique passage, was at once perceived.

From experiments performed in this way last summer, it follows that half of the incident light which might pass through a field of air of the ordinary density and $15\frac{1}{2}$ miles of extent, would penetrate only to the perpendicular depth of 15 feet in the clearest sea-water, which is, therefore, 5400 times less diaphanous than the atmospheric medium. The light is hence diminished four times for every five fathoms of vertical descent; and, consequently, the 64th part only could reach to the depth of 15 fathoms. Supposing the bottom then to consist of a clear white sand, the portion of light reflected, and sent back to the surface, would be attenuated more than 64×64 or 4096 times, and would therefore hardly be perceptible to the most acute eye. But the water of shallow lakes, though not apparently turbid, betrays a still greater opacity, insomuch that the perpendicular light was diminished one-half, in descending only through the space of six feet in Loch Leven, or even two feet in a fine artificial sheet of water at Raith, near Kirkaldy. These results, however, are to be considered as mere approximations, the state of the weather having been very unfavourable for such experiments.

It would be easy, by a small modification, to adapt the photometer as a diaphanometer, for measuring the comparative transparency of different collections of water. The black and the clear ball might be blown larger than usual, and the instrument covered with two thin parallel cases of glass, separated by an interval of about three-eighths of an inch. The transparency of a lake, or of the sea, would be inversely as the length of passage traversed by the light, when it had suffered a proportional diminution of intensity.

Construction of the Æthrioscope.

VII. ÆTHRIOSCOPE.*—Such is the name of another very delicate modification of the differential thermometer, intended to measure those frigorific impressions which are showered incessantly from the distant sky. The history of this invention, and of its progressive improvement, has been given already in this *Supplement* (Art. CLIMATE). Since that time, few good observations have been added, owing to the very cloudy and windy weather which has prevailed for almost two years. The chief object then was to render the æthrioscope more portable, in the hope of obtaining, through it, some correct information regarding the state of the atmosphere in other quarters of the globe. The upper ball is now scarcely half an inch in diameter; but to compensate for this diminution, the lower ball has a diameter of about four-fifths of an inch. The tube, which exceeds not four inches in length, has its bore contracted a little above its junction to the very short cylindrical cavity that holds the coloured liquor; this simple contrivance, augmenting greatly the capillary action, prevents the descent of the column into the ball from any sudden change of temperature, while it only retards the motion of the fluid, without affecting the accuracy of its play. Fig. 10, Plate XCVII. represents the instrument in this abridged form, and fig. 11 shows the way of packing it, the bottom being merely screwed to the top of the case. The only precaution needed, is not to shake the æthrioscope or invert it; and as it takes very little room, it may easily be carried by the traveller in his pocket. We may soon expect information, at once curious and interesting, from remote climates.

Theory of this Instrument.

In ordinary cases, the hot or cold pulses propagated through the air only assist the energy of the transfer of the different portions of the fluid, in promoting an equilibrium of temperature. But the æthrioscope proves that those pulses are incessantly forwarding such a balance, even while the mere transfer and commixture of the medium would not contribute to the effect. In the article CLIMATE, it was shown that the rapid interchange which takes place between the higher and lower strata of the atmosphere, maintains an equal distribution in the *quantity*, and not in the *intensity*, of heat. Since air has its capacity for heat increased by rarefaction, it must, with the same igneous infusion, indicate a proportionally depressed temperature. But this inequality of temperature, resulting from the internal commotion produced by the sun's rays acting more powerfully near the surface of the earth, is partly corrected by the influence of the cold or hot pulses, which are at all times darted and in every direction, unless obstructed or absorbed by the interposition of the clouds. While the cold pulses from the upper strata of the atmosphere are constantly chilling the lower strata, the warm pulses again from below are exerted in warming the higher regions. In most cases this mutual influence, indeed, is comparatively feeble; but if the rays of the sun were withdrawn for any considerable time, a great progress would be made by such a mutual interchange of the pulsations towards an equality of temperature through the mass of atmosphere. The lowest strata would become unusually colder, while the highest regions would grow warmer, and sparkle with augmented clearness and lustre. Such are some of the effects of the long protracted nights within the Arctic Circle.

Its Inverted Form.

Much yet remains to be explored in the higher

* From Αἴθριος, which signifies at once *clear*, *dry*, and *cold*.

strata of our atmosphere. If the differential thermometer, included within the æthrioscope, had its position reversed, that instrument would become adapted to measure the hot pulses, which are, no doubt, shot incessantly upwards with various obliquity from the warmer beds incumbent over the surface of the earth. It would be most interesting to obtain the reports of both the erect and the pendant opposite æthrioscope; when carried up in the car of a balloon to the elevation of four miles. In that region of mid-air, we might expect the hot and the cold pulses, as they crossed in opposite directions, to act with nearly equal energy. The measures of those effects, compared with the simultaneous indications of the photometer, could not fail to dispel much obscurity, and to open new views of the disposition of the elements, and of the economy of nature.

Construction of the Cyanometer.

VIII. CYANOMETER.*—This instrument was contrived by M. de Saussure, to measure the variable intensity of the cærulean hue, which the sky assumes in different climates and elevations, according to the progress of the day or the advance of the season. It consists of 53 slips of paper of about a quarter of an inch broad, stained with the successive shades of blue, from the palest sapphire to the deepest azure, which are pasted around the circumference of a circle of pasteboard of about four inches in diameter. The colours were obtained from fine Prussian blue, diluting it with white chalk, or darkening it with a mixture of ivory black. He likewise compared those coloured spaces with the pure tints of a solution of copper in ammonia, which resemble most the soft transparent hues of the atmosphere. To represent the effect of clouds, and diffuse aqueous vapours, he dropped into that liquid a portion of very fine divided argillaceous earth, precipitated by ammonia from a solution of alum.

In observing with the cyanometer, it should be held out of doors, between the eye and the part of the heavens which is to be compared, and, with a little practice, the corresponding tint is easily distinguished.

In this way, Saussure found, that the deepest blue of the zenith on the summit of Mont Blanc, at his station on the Col du Geant, at Chamouni, and at Geneva, corresponded respectively to the shades, denoted 39, 37, 31, and 26½. From morning till noon, the colour of the vertical sky darkened, but became lighter again as the evening advanced; and this transition was wider and more rapid in great elevations. On the Col du Geant, the tint of the horizontal air at sunrise was 5, it deepened to 11½ at noon, but again relapsed to 5 towards night. On the 15th of July, which was a very clear day, the atmosphere at the horizon had the 11th shade; at the altitude of 10°, the 20th; at that of 20°, the 31st; at that of 30°, the 34th; at that of 40°, the 37th; and thence with any sensible variation to the zenith. Baron Humboldt, in his voyage from Coruña to Cumana, found the tints of the sky to vary by the cyanometer, from 13 to 24, and again to 16, while the colour of the ocean fluctuated between 34 and 44.

The misfortune is, that we cannot annex any very distinct ideas to these numbers. We are not informed even of the proportions of the ingredients of the series of colours. The manner of composition likewise will modify the colorific effect; and most of the pigments, and especially the Prussian blue, not only want uniformity of tone, but are subject to great alteration. It would be quite impossible to paint with any water colours two cyanometers that should continue to agree, after being exposed for some time to the action of the air and the sun.

Composition of Colours

If an accurate method could be devised to discriminate colours, and mark their different tints with a sort of numerical precision, it would prove a valuable acquisition to philosophy and the arts. This was first attempted by the famous painter Leonardo da Vinci. Zahn proposed, in 1702, to accomplish it, by the graduating mixture of primary colours dispersed over the surface of a triangle; but he reckoned five of those colours, including *black* and *white*, with *red*, *yellow*, and *blue*. The celebrated Professor Mayer of Gottingen, after various trials, simplified the procedure in a posthumous work, published by Lichtenberg in 1775. Having distinguished each side of an equilateral triangle into 13 equal parts, he subdivided the whole space into 91 small triangles, which he painted with the successive mixtures of *vermillion*, *ultra-marine*, and *bright orpiment*. Lambert assumed three colours, *carmine*, *Prussian blue*, and *gamboge*, to cover a triangular base, upon which he erected a coloured pyramid, having *white* planted at its apex. But Dr Thomas Young, whose authority in those matters has deservedly great weight, prefers the simple triangle, and adopts *red*, *green*, and *violet* for the primary colours. Their binary combinations are *yellow*, formed by mixing red with green; *crimson*, consisting of red and violet; and *blue*, produced by blending green with violet. The difficulty, however, is to regulate the intensity of the compounds; nor can the powders be safely mixed except in a dry state, lest some chemical action should be introduced which might alter their tints. But the colours thus combined must evidently want the freshness and brilliancy of those which nature paints, or which the prism reveals.

Air, like water, is no doubt, by its constitution, a coloured fluid. The former is naturally blue, as the latter is green; but these colours acquire intensity only from the depth of the transparent mass. A small body of limpid water has the appearance of crystal, but in proportion as it accumulates, it assumes all the successive shades till it rivals the tints of the emerald and the beryl. This gradation is distinctly seen in the profound lakes of Switzerland, whose lustre is never stained by any vegetable infusion. The same series of colours emerges, on receding from our shores and approaching the vast abyss of the Atlantic Ocean. At first, the water on the shelving banks is merely translucid; at the depth

* From Κυανος, *cærulean* or *sky-blue*, and μετρον, *a measure*.

of ten fathoms, it appears greenish, and the tint, by degrees, becomes more intense till it passes into a full green, at the depth of fifty fathoms; but beyond soundings, it darkens almost into azure.

In like manner, the blue shade of the air becomes more intense in proportion to the length of the tract of light. This we perceive in viewing distant objects, whose colours are always tinted by the deepening hues of the interjacent range of atmosphere. The remotest hills seem lost in a cærulean vesture. The mixture of aqueous vapours only diffuses a mist, which tarnishes rather than dilutes the fine blue.

It must be observed, that no substance can disclose its inherent colour, but by a sort of internal secretion or dissection of the rays of light. The mere reflexion from the surface of a solid body could never betray its tints, for when rendered most perfect by polish, it would only, like a mirror, send back unchanged the incident beams. To detect the subjacent colour, it is necessary that the particles of light should at least penetrate under the surface, and after suffering a sort of chemical separation, should be again emitted. In transparent substances, whether solid or fluid, the penetration is greater, but the mode of evolving the native colours must be still the same. The atmosphere, besides dispersing internally the blue rays, likewise reflects in various proportions the white light unaltered. This fact is established by some experiments of *polarization*, which show that such simple reflexions are the most copious from the portion of the sky which is 90 degrees from the sun, and regularly decline on either side to the opposite points, where they cease altogether.

The white, or compound beam of light, suffering in its passage through the air, a continual defalcation of the blue rays, must, as it advances, assume the complementary colour, or the tints of the remaining portions of the spectrum, and therefore merge successively into yellow, orange, red, and crimson. Such, accordingly, are the graduating colours of the solar rays, as they approach to their extreme obliquity. Near sun-setting, the shadow of a pencil along a blank card appears a bright azure on a lilac ground. When a diffuse attenuated vapour reflects the incident light unaltered, the western sky, as the sun declines from his altitude, glows with the successive shades of yellow and orange, which deepen finally into a blush red. These colours again may, under certain circumstances, come to be blended with the natural blue of the atmosphere. Hence the explication of a curious phenomenon, which rarely occurs in this climate,—the existence of *green clouds*. This happens in the mornings and evenings, when a thin cloud is illuminated at once by the yellow rays of the sun and the bright azure of the upper sky, these contrasted colours producing a *green* by their mixture For the same reason, sometimes a portion of the bright sky appears, in the finer climates, tinted with violet. This was remarked by Humboldt in his voyage to America and we have had occasion to observe the same at Avignon. It was no doubt occasioned by the reddish rays of the declining sun dyeing the intense blue of the higher atmosphere.

Another form proposed.

The easiest and readiest way of ascertaining the tints of different portions of the sky, is perhaps to employ a sharp wedge of blue glass, of which the base and the parallel sides are painted black and cased with thin brass, and the slanting sides are ground to true planes and highly polished. To these angular surfaces two slides might be adapted, having each a broad slit, or intermediate opening, to permit the entrance and transmission of white light. Such rays having a greater length of passage to traverse, according to their distance from the top of the wedge, must emerge with a proportional intensity of blue. The scale would hence be determined by dividing the slides into ten or twenty equal parts, which might probably be sufficient.

To examine the orange and crimson tints which gild the east in the morning, or suffuse the western sky on the approach of evening, it would be necessary to combine a series of the complementary or accidental colours. A wedge of glass, stained of a gold-red or deep orange, might answer the purpose; or perhaps a nearer approximation would be obtained by joining two reversed wedges, one of an angle of 8 degrees, and crimson coloured, and another having only 3 degrees, but of a yellow body.

These instruments might be reduced to a very convenient size, not exceeding four inches in length, but they would require to be formed out of the same mass of glass, and exactly after the same pattern With some skill in the execution, they could be made to unite elegance and correctness.

Anemometer.

IX. Anemometer.*—Various attempts have been made to construct an instrument that should readily indicate the force and velocity of the wind. One method was to employ a very small model of a windmill, and either to reckon its revolutions, or to estimate its power by the application of a weight to a conical barrel or axis. But a more direct and accurate procedure consisted in measuring the impulse of wind against a vertical plane, as intimated by the contraction of a spiral spring. All these instruments, however, act with such extreme irregularity, as scarcely ever to furnish any definite results. They are, besides, racked by incessant motion, and soon put out of order.

We may notice, however, a material improvement made in this construction of the machine, by Mr Waddel, of the Trinity-House, Leith, who, amidst other objects of useful experimental inquiry, has long directed his ingenuity to ascertain the force and velocity of the wind. A circular plate, of four inches diameter, is opposed to the blast; but instead of pushing against a spring, it presses a fine cylindrical bag, of about an inch long, and the third part of an inch diameter, filled with quicksilver, and joined tight to a vertical tube of glass, a foot or 15 inches high; but having a bore only the 20th part

* From Ανεμος, *the wind*, and μετρον, *a measure*.

of an inch wide. The compression of the bag caused by the impulse of the wind upon the plate, squeezes the quicksilver up into the tube, carrying with it a small steel mark, which slightly adheres to the sides of the bore. The height of the mercurial column, diminished in the ratio of the surface of the plate to the section of the bag, must evidently give the measure of the force of the wind. But, in the actual exposure of this anemometer, the quicksilver oscillates excessively, so that the extreme effects only are indicated. The instrument, however, is very sensible, and may continue to act for a long period without being impaired.

Its Improved Construction.

The direct action of the wind in supporting a column of water appears to furnish the best and simplest kind of anemometer. This principle was first employed, in 1731, by Pitot, the French engineer, in his recurved tube for estimating the force of the current of a river; and, forty years afterwards, it was applied by Dr Lind, to measure the impulse of a stream of air. With some modifications to correct, or at least to diminish, the oscillations of the liquid, this instrument is rendered quite manageable. The tube may consist of two pieces, each about a foot in height, having bores of the fiftieth and the fifth parts of an inch, the narrow piece being swelled out into a cylinder perhaps an inch wide, and two inches long, near the end where is joined hermetically to the other piece. The top of the narrow tube is bent horizontally, and cemented into the centre of a vertical circle of plate glass, of about three inches in diameter; or, instead of this plane, a hollow segment of a sphere of the same expansion, but including only 30 or 40 degrees, is substituted. The top of the wide tube is likewise bent horizontal, and drawn to a point at the same height as the minute central orifice of the cavity, and bent in the opposite direction. A portion of nut-oil, tinged by the alkanet root, had been previously introduced into the cylindrical cistern. On turning the small plate, or bason, to front the wind, a condensation, corresponding to its force, is immediately produced on the opposing surface, a small portion of air enters the orifice, and continues to press upon the oil, till this rises to form an equiponderant column in the wide tube. As the air can with difficulty penetrate through the very narrow bore, the irregular action of the blast is, in a great measure, corrected, and the oil moves rather tardily.

A scale is adapted bearing two sorts of divisions, the one indicating the impulse, and the other the velocity of the wind. Reckoning the weight of the atmosphere equivalent to a column of oil of 400 inches in altitude, this space is subdivided into 10,000 equal portions, each degree thus corresponding to the 25th part of an inch. It would hence be easy to show, that the pressure of the wind upon every square foot of surface is expressed in pounds avoirdupois, by dividing by five the number of degrees through which the oil ascends.

But we may place an adjacent line of subdivisions that shall mark the velocity of the wind in miles each hour. Since air will rush into a vacuum, at the rate of 1350 feet in a second, it would, under a predominating pressure of the 100th part of an atmosphere, or at 100 degrees, flow with a celerity ten times less, or 135 feet in a second, which corresponds to 92 miles in an hour. Wherefore, 25 degrees of the scale of impulse would be marked by a velocity of 46, and $6\frac{1}{4}$ degrees by that of 23 miles an hour. The subordinate divisions could hence be easily formed.

Such are the velocities which theory would assign to the different altitudes of the columns supported by the force of the wind. But the actual resistance of fluids, owing chiefly to their detention at the obstructing surface, generally exceeds the result of calculation. In the case of water and air, the ratio of excess appears from experiment to be nearly that of 8 to 5. We may therefore modify the velocities after this proportion above stated. The relations of celerity and impulse will stand thus:

Celerity in Miles per Hour.	Impulse in 10,000th Parts of the Weight of the Atmosphere.
10	1°.9
20	7°.6
30	17°.1
40	30°.4
50	47°.5
60	68°.4
70	93°
80	121°.5

This anemometer, being furnished with a vane to make it always face the wind, might also, by an index, point out the direction. Nor is it absolutely requisite that the instrument should be exposed out of doors. The funnel, with its vane, may have a socket of bell-metal, nicely fitted to the top of a long perforated brass tube, which descends from the roof of the house, and terminates below in the recurved tube and its double scale. The impressions of the wind would thus be conveyed with great regularity and undiminished effect to the surface of the oil. Still, however, it would be impossible to avoid entirely the oscillations of the liquid column. Even the steadiest wind will be found to blow with a reciprocating force, now swelling and again relaxing, and, at certain short intervals, concentrating all its vehemence.

Ombrometer.

X. OMBROMETER,* or RAIN-GAUGE.—A very simple instrument, contrived to indicate the quantity, or rather the depth, of the rain which falls upon any spot. It is likewise named *Hyetometer*, and has been sometimes called by the barbarous compound *Pluviameter*. It is composed generally of a circular bason of tinned iron, soldered to the top of a vertical cylinder, which is contracted in some given proportion and closed below. A small float is introduced, bearing a slender rod, distinguished by the corresponding divisions. In the most ordinary con-

* From Ομβρος, *rain*, and μετρον, *a measure*.

Meteorology.

struction, the bason being a foot wide, the attached cylinder has 3⅘ inches in diameter, and its section is consequently ten times smaller. The inches on the rod are hence marked only tenth parts.

This method of measuring the fall of rain is evidently not susceptible of much accuracy; and it would require the gauge to be very frequently visited, on account of the loss of the water by continual evaporation. The more correct ombrometers have their bason made of brass, and turned to a fine sharp edge; the rain, as it falls, runs though a small orifice into the vertical cylinder, which has only about the fourth part of the diameter, and communicates, by means of a cock, with another perpendicular tube still narrower, and consisting of glass having a scale affixed. The divisions of this scale are determined from the proportion of the joint sections of the cylinder and tube to the horizontal surface of the bason. In making an observation, the cock being turned, lets the collected water rise to the same level in the glass tube, and thus indicate its quantity, which, by another operation, is now drawn off. In the time of frost or snow, it becomes necessary to warm the instrument gently, and make the water flow.

We may suspect that the measure of the rain, hail, or snowy flakes received by the ombrometer, is not exactly proportioned to the extent of surface which it presents, for, while torrents pour down from the heavens, an eddy plays about the rim of the bason, deranging the regularity of the discharge. A bason of several feet in diameter would perhaps be preferable; or the platform of a roof could be adopted, if it were sufficiently sloped to allow the rain to collect quickly.

Varia[illegible] Indications.

But the most perplexing circumstance affecting the ombrometer is, that it has been found to indicate very different quantities of rain as falling upon the very same spot, according to the different elevation at which it was placed. In general, less rain is collected in high than in low situations, even though the difference of altitude should be inconsiderable. Thus it was discovered, that, in the space of a year, while 12.1 inches only fell on the top of Westminster Abbey, 18.1 inches were collected on the roof of a house sixteen feet lower, and even 22.6 inches of rain at the ground. Similar observations have been made at the summit and near the base of hills of no great elevation. In such situations, we can hardly suppose the clouds to stretch down to the surface, or to augment the lower portion of rain. We must hence refer the copious fall near the ground to some other cause. Most of the rain which falls proceeds from drifting showers of short duration. The current moves more slowly along the surface, and allows the drops to descend as fast as they are formed. But being forced to mount a swelling eminence, and thus compressed into a narrower stream, it hurries the mass of vapour along with it, and does not suffer the free or full discharge on the summit. On both sides of the hill, an ombrometer placed near the bottom indicates always a greater fall of rain than on the exposed top.

The observations furnished by this instrument are hence liable to considerable inaccuracy, unless made in an open champaign country. Thus, a register kept at Keswick gives 67½ inches, which evidently exceeds greatly the annual fall of rain in that district; the quantity at Carlisle, not 25 miles distant, being only 20 inches. Again, the measures of rain, being 33 and 34½ inches in the open country about Manchester and Liverpool, are found to amount to 45 and 60 inches at Lancaster and Kendal, which approach the flanks of a mountainous range. In general, twice as much rain falls on the western as on the eastern side of our island; and the average annual quantity may be reckoned at 30 inches, or it would form, if all collected, a sheet of water of that depth. According to this estimate, the whole discharge from the clouds in the course of a year, on every square mile of the surface of Great Britain, would, at a medium, be 1,944,613, or nearly two millions of tons. This gives about three thousand tons of water for each English acre.

Electrometer.

XI. ELECTROMETER,* which detects the electrical state of the lower atmosphere. The best instrument of this kind undoubtedly is Bennet's, consisting of two slips of thick gold-leaf suspended from a knob within a small cylinder of glass, which is surmounted by a cap of brass. This may be connected with an insulated rod or wire, extending a few feet beyond the window.

The electrometer indicates the condition of the air only in its immediate vicinity. But when thunder storms prevail, the atmosphere becomes affected to a very considerable extent. Yet the indications of the electrometer are often capricious and evanescent. Whenever clouds are suddenly formed, or melt way, whether the air changes to dryness or humidity, the electrical equilibrium is disturbed. The observations made with the electrometer are hence of much less importance than was once expected, and have been gradually falling into neglect.

Drosometer.

XII. DROSOMETER.†—An instrument so called was proposed by Weidler, a German professor, in 1727, to measure the quantity of dew which gathers on the surface of a body which has been exposed to the open air during the night. It consisted of a bent balance, which marked in grains the preponderance which a piece of glass of certain dimensions, laid horizontally in one of the scales, had acquired from the settling and adhesion of the globules of moisture.

The main objection to a drosometer of such a construction is, that it would require to be protected from the action of the wind, and being thus screened, it could not receive the whole of the dew which might otherwise have been deposited. The steel beam too, from continual exposure to the weather, would soon lose its polish, and become unfit for any accurate performance. Besides, it is in general easier to measure than to weigh a portion of liquid.

* From Ηλεκτρον, *amber*, and μετρον, *a measure*.

† From Δροσος, *dew*, and μετρον, *a measure*.

A simpler and more convenient drosometer could be formed on the principle of the ombrometer, or rain-gauge. Suppose a glass funnel, of about three inches diameter, whose interior surface is very smooth and slopes towards the centre, at an angle of 15 or 20 degrees, to be joined hermetically to a long tube, sealed at the lower end, and having an equable bore not exceeding the quarter of an inch, with an attached scale divided into portions, corresponding to the thousandth parts of an inch, on the external aperture. The only difficulty is to make the dew which gathers during the night to run down the sides of the funnel into the tube. To facilitate this descent, a coat of deliquescent salt of tartar may be spread with a hair pencil over the shallow surface, and renewed as often as occasion requires. The dew, instead of settling in minute detached globules, would then be attracted by the alkaline lye, which thus becoming dilute, would gradually flow into the narrow cavity of the tube. It would be easy at any time to make an allowance for the very small portion of liquid alkali blended with the dew.

Meteorological Registers.

Such is the complete apparatus required for keeping a meteorological register. But those instruments are not all of equal importance. The barometer, the thermometer, and the hygrometer, may be considered as indispensable. Next to them deserve to be ranked the photometer and æthrioscope, which disclose the more recondite condition of the atmosphere. The atmometer, the ombrometer, and the anemometer, besides, are of consequence, from the practical results which they furnish.

The value of any meteorological register, however, depends on the accuracy with which it is kept. The observations should be made in a place rather elevated, and exposed freely on all sides to the aspect of the sky; and they should be repeated either at equal intervals, during day and night, or at least at those hours which represent most nearly the mean state of the atmosphere. These requisites are seldom attained, and very few registers of the weather, accordingly, are entitled to much confidence.

It cannot be expected, that registers of the weather will possess much value, so long as they are kept merely as objects of curiosity. Like astronomical observations, as now conducted, they should no longer be left to the chance of individual pursuit. They would require to be unremittingly prosecuted in all variety of situations, and at the public expence. Proper sets of meteorological instruments should be placed not only in the regular Observatories, but sent to the different Forts and Light-houses, both at home and at our principal foreign stations. They might also be distributed among the ships employed in discovery, or engaged on distant voyages. The cost of providing those instruments would be comparatively trifling, and the charge incurred, by keeping registers on a regular and digested plan, might shrink to nothing in the scale of national expenditure.

The state of the barometer alone is kept with tolerable accuracy, because that instrument, being little influenced by collateral circumstances, marks nearly the same impressions over a wide extent of surface. The thermometer, again, is seldom observed at the proper hours, or in a situation sufficiently detached from the buildings and solid walls.

It is customary, for the sake of convenience, to note the thermometer in the morning, at the height of the day, and again in the evening. But these three observations must evidently furnish results below the medium temperature of the whole twenty-four hours, since the accumulated warmth is reckoned but once, while the freshness partaking of the night is counted twice. It would be nearer the truth to assume the middle point between the maximum and minimum though even this cannot be deemed absolutely correct, because the heat neither mounts nor declines in an uniform progression. The hottest time of the day is generally about two o'clock, and the coldest just before sunrise. This hour of extreme descent is consequently very variable; and it would be difficult to fix the times suited for observing, unless they were more multiplied. But even fewer observations may sometimes be made to serve the purpose. In this climate, the daily average may be reckoned from eight o'clock of the morning, and the month of October is found to have nearly the mean temperature of the whole year.

The observations usually made with the hygroscopes of Deluc or Saussure cannot be regarded as affording any definite indication of the dryness of the atmosphere. It would essentially contribute to the advancement of meteorological science, if the hygrometer which we have described were introduced into general practice. This adoption cannot be very distant.

Some of the monks, in the religious houses scattered over the Continent, might find an agreeable and useful occupation in recording the state of the atmosphere. Many of these establishments are seated in lofty and romantic situations; and several of them, destined by their founders for the charitable accommodation of travellers, occupy the summits of the most elevated and inaccessible mountains. Accurate registers kept in such towering spots are peculiarly interesting.

Light-houses would, from their usual position, be well fitted for observing the force and direction of the wind, and the swell and relapse of the tide. The navigators who traverse the ocean in every latitude might, besides keeping meteorological soundings, record the variation of the needle, and examine the intensity of magnetic attraction.

To promote the science of meteorology, it would be most expedient that the various learned associations, planted in different parts of the globe, should institute inquiries into the state and internal motions of the higher strata of our atmosphere. As the ultimate results could not fail to prove advantageous to the public, the several governments might be expected to defray the moderate expence incurred in carrying this plan into effect. Light small balloons might from time to time be launched towards the most elevated regions, to detect by their flight the existence and direction of currents which now escape observation. Barometers, thermometers, hygrometers, and perhaps æthrioscopes, in compact forms, and which should register themselves, might be sent up in the car. Observers, furnished with accurate

Meteorology. and complete instruments, could likewise be dispatched occasionally to the intermediate heights in large balloons. By classing the various meteorological journals, and combining those ulterior facts, some new lights could not fail to be struck out, which would gradually reveal that simple harmony, which no doubt pervades all the apparent complication of the universal frame. Till we obtain such insight, we must content ourselves with the best explications of the phenomena of the atmosphere, which our imperfect and limited knowledge will admit. We shall, therefore, treat in succession of the origin of winds; the generation of clouds and fogs; and their precipitation in the form of rain, snow, or hail. Other collateral objects will be discussed, as they present themselves to view. The narrow space which we have allotted to this discourse must confine our remarks to the more general topics.

Cause of Wind. 1. Wind.—It is a curious circumstance, that in all languages the ordinary name of *air* refers to its mobility, and merely signifies *to blow*. This impulse alone of the fluid appears to have awakened our sensations; and had the atmosphere continued perfectly still, we might for ages have remained ignorant of the very existence of the fluid which we breathe.

The main cause of *wind*, or the flow of air, is undoubtedly the variable distribution of heat through the atmosphere, which incessantly affects the local density, and disturbs the equilibrium of the mass. The presence of the sun affects the surface of the terraqueous globe, which again warms and dilates the lower strata of atmosphere. The calorific action of the solar beams is greatly diminished by their obliquity; it rapidly accumulates on the land, but becomes attenuated and diffused in the waters of the ocean.

The alternation of day and night, and the annual revolution of the seasons, are hence the perpetual sources of winds. If the surface of the globe, however, had been wholly covered by the ocean, and not disparted by land and seas, those winds must have been scarcely perceptible. The daily illumination of the sun does not warm the ground to the depth of an inch; but the same quantity of illumination penetrates, though with a decreasing intensity, many fathoms into water, spreading and dividing its influence. We may reckon the tenth part of the incident light to be intercepted by a superficial stratum of the thickness of one foot; and it will hence follow, that the solar beams communicate every day a hundred times less heat to the surface of a body of water than to an expansion of level ground. The subsequent influence again of those contrasted surfaces in warming the incumbent air, must be proportionally different, though slightly modified by the portion of light reflected from the water. In a general view, the diurnal variation of temperature in the atmosphere may be considered as limited to the lowest stratum, not exceeding 2000 feet in height. Such a body of air will intercept commonly the fiftieth part of all the light which traverses it. We may hence conclude, that the change of temperature in the air, caused by the succession of day and night, is, on the whole, about thirty times less above a spacious lake than over the surrounding land.

The current which rushes from all sides towards any heated portion of the atmosphere is easily explained and computed from the diminution of pressure which rarefaction produces at that place. The celerity of the flow is precisely the same as that of the efflux from a small aperture under the pressure of a column equivalent to that diminution, or to the difference between the weight of the warm air and of an equal volume of the exterior fluid. Thus, suppose a chimney 20 feet high, were heated up 50 centesimal degrees, or 90 on Fahrenheit's scale; the air in the flue being therefore expanded one-fifth part or four feet, would be driven upwards by the pressure of a column compensating this difference. The velocity of the discharge would hence be $8\sqrt{4}=16$ feet every second, or at the rate of about eleven miles in the hour. If a fire be kindled in an open field, it is evident that the rush of air must proceed from all sides. At the spot itself, therefore, the opposite currents will produce a counter balance, and no dominant wind can prevail. But if the warm air should cover a very wide extent of surface, its influence may be felt at a great distance, and the several converging winds may have space to blow without any mutual interference.

Sea and Land Breezes. These views afford a complete explication of the phenomena of sea and land breezes, which are occasionally met with in every latitude, but are constantly observed near the shores of the continent, and of the larger islands within the tropics. In those sultry regions, as the day advances, a refreshing wind blows from the sea, and is succeeded by an opposite current from the interior of the land on the approach of evening, and during a great part of the night. In open seas, and especially near the equator, the thermometer scarcely varies a degree, and very seldom two degrees, by Fahrenheit's scale, in the whole course of a day. But on the land the change of temperature between the night and day, in similar situations, will rise often higher than 70 centesimal degrees, or 126 of Fahrenheit. If we, therefore, conceive a stratum of air 2000 feet in altitude, heated only to the mean difference, or three centesimal degrees, it would receive an expansion of 24 feet; whence the velocity of the wind produced would be $8\sqrt{24}=39$ feet every second, or at the rate of 26 miles in the hour. This is a very moderate estimate; but the celerity of the current must, no doubt, be diminished from the retardation which it suffers in proportion to the length of track over which it has to sweep.

During the night the lower atmosphere is colder on land than at sea, owing partly to the descent of the more elevated and colder portions of air which chill the surface of the ground, and partly to those cold pulses which are incessantly darted from every point of the azure sky. If we reckon the reduced temperature of the land only a centesimal degree and a half below the standard of the adjacent ocean, this would give 12 feet for the contraction of the vertical column of air, and, consequently, a stream would flow towards the sea with a celerity of $8\sqrt{12}=28$ feet *per* second, or very nearly 20 miles every hour. In general, the land breeze may be considered not so powerful as what blows from the sea.

The ordinary appearances are clearly and graphically described by that very intelligent and enterprising navigator, Captain Dampier:

"These sea-breezes do commonly rise in the morning about nine o'clock, sometimes sooner, sometimes later. They first approach the shore so gently, as if they were afraid to come near it, and oftimes they make some faint breathings, and as if not willing to offend, they make a halt, and seem ready to retire. I have waited many a time both ashore to receive the pleasure, and at sea to take the benefit of it.

"It comes in a fine, small, black curl upon the water, when as all the sea between it and the shore not yet reached by it is as smooth and even as glass in comparison; in half an hour's time after it has reached the shore it fans pretty briskly, and so increaseth gradually till twelve o'clock, then it is commonly strongest, and lasts so till two or three a very brisk gale; about twelve at noon it also veers off to sea two or three points, or more, in very fair weather. After three o'clock it begins to die away again, and gradually withdraws its force till all is spent, and about five o'clock, sooner or later, according as the weather is, it is lulled asleep, and comes no more till the next morning.

"These winds are as constantly expected as the day in their proper latitudes, and seldom fail but in the wet season. On all coasts of the main, whether in the East or West Indies, or Guinea, they rise in the morning, and withdraw towards the evening, yet capes and head-lands have the greatest benefit of them, where they are highest, rise earlier, and blow later.

"Land-breezes are as remarkable as any winds that I have yet treated of; they are quite contrary to the sea-breezes; for those blow right from the shore, but the sea-breeze right in upon the shore; and as the sea-breezes do blow in the day and rest in the night, so, on the contrary, these do blow in the night and rest in the day, and so they do alternately succeed each other. For when the sea-breezes have performed their offices of the day, by breathing on their respective coasts, they in the evening do either withdraw from the coast, or lie down to rest. Then the land-winds, whose office is to breathe in the night, moved by the same order of Divine impulse, do rouse out of their private recesses, and gently fan the air till the next morning; and then their task ends, and they leave the stage.

"There can be no proper time set when they do begin in the evening, or when they retire in the morning, for they do not keep to an hour; but they commonly spring up between six and twelve in the evening, and last till six, eight, or ten in the morning. They both come and go away again earlier or later, according to the weather, the season of the year, or some accidental cause from the land: for on some coasts they do rise earlier, blow fresher, and remain later than on other coasts, as I shall show hereafter.

"These winds blow off to sea, a greater or less distance, according as the coast lies more or less exposed to the sea-winds: for in some places we find them brisk three or four leagues off shore; in other places not so many miles, and in some places they scarce peep without the rocks, or, if they do sometimes in very fair weather make a sally out a mile or two, they are not lasting, but suddenly vanish away, though yet there are every night as fresh land-winds ashore at those places as in any other part of the world.

"Indeed, these winds are an extraordinary blessing to those that use the sea in any part of the world within the tropics; for as the constant trade-winds do blow, there could be no sailing in these seas; but by the help of the sea and land-breezes, ships will sail 200 or 300 leagues, as particularly from Jamaica to the Lagune of Trist, in the bay of Campeachy, and then back again, all against the trade-wind.

"The seamen that sail in sloops or other small vessels in the West Indies, do know very well when they shall meet a brisk land-wind by the fogs that hang over the land before night; for it is a certain sign of a good land-wind to see a thick fog lie still and quiet, like smoke over the land, not stirring any way; and we look out for such signs when we are plying to windward. For if we see no fog over the land, the land-wind will be but faint and short that night. These signs are to be observed chiefly in fair weather: for in the wet season fogs do hang over the land all the day, and it may be neither land-wind nor sea-breeze stirring. If in the afternoon also in fair weather we see a tornado over the land, it commonly sends us forth a fresh land-wind.

"These land-winds are very cold, and though the sea-breezes are always much stronger, yet these are colder by far. The sea-breezes, indeed, are very comfortable and refreshing; for the hottest time in all the day is about nine, ten, or eleven o'clock in the morning, in the interval between both breezes: for then it is commonly calm, and then people pant for breath, especially if it is late before the sea-breeze comes, but afterwards the breeze allays the heat. However, in the evening again, after the sea-breeze is spent, it is very hot till the land-wind springs up, which is sometimes not till twelve o'clock or after."—(*Voyages*, Vol. II.)

Nature of the Trade Winds.

The TRADE-WINDS, which, within the tropics, at all times constantly blow from the east, but somewhat vary their force, and decline a little to the north or the south, according to the latitude and the season—are the most remarkable of all the aërial currents, and of signal importance in navigation. These steady breezes favoured the voyage of Columbus, and conducted him to the discovery of the Mexican Archipelago. The same powerful stream afterwards drew the Portuguese from their southern course, and carried them to the shores of the Brazils. Since the character and extent of those winds have become perfectly known, the navigator reckons safely on their aid, and shapes his voyage in such a way as to reduce its performance almost to a calculation.

The cause of the trade-winds, however, is not obvious, or very easily traced. Various attempts have been made to explain the phenomenon, yet seldom on any solid or accurate principles. It would form an interesting discussion to examine the dif-

ferent hypotheses advanced; but we can afford room to notice, very briefly, the more considerable only of those opinions.

Des Cartes and his followers imputed the trade-winds to the inertia of the atmosphere, which they conceived to prevent this fluid from acquiring the full rotation of the earth, especially near the equator. The air being thus left behind as the globe rolled from the west, would have an apparent motion in the contrary direction, and seem to blow from the east. But it may be urged, that as passengers almost insensibly gain the celerity of the ship which carries them, so every portion of the incumbent atmosphere, though more loosely adherent to the terraqueous surface, must soon acquire the peculiar motion corresponding to the parallel of latitude. Nor would the inequality of such combined movements in the air at all disturb the order and arrangement of its general mass.

Halley's Hypothesis.

Dr Halley gave a different explication of the origin of trade-winds, which seems very plausible, and has long been deemed quite satisfactory. This able philosopher and experienced navigator supposed, that the spot where the sun's vertical rays exert their utmost heating energy, being in the lapse of a day successively transferred from east to west round the circumference of the globe, must, as a centre of confluence, draw in its train a current of air. The current thus formed would result from the excess of the streaming from the east above that from the west; and it would therefore advance with a tardy pace, following at a distance the powerful energy of the sun. The same easterly wind might incline towards the north or the south, according as the great luminary appears to approach to the northern or the southern tropic.

But it should be observed, that the torrid zone stretches mostly over the ocean, and includes only a narrow portion of land. The heat excited in succession through that liquid track, by the diurnal passage of the sun, is hence extremely small, and hardly sufficient to produce the aspiration of the gentlest air. Nor could even this feeble current have a decided and constant direction. It would only tend towards the heated part of the surface of the ocean. In the morning, it would breathe from the west; about noon, it would become neutral, and die away; and, in the evening, it would again spring up, and flow from the east. Near midnight this current would sink into a perfect calm. The hypothesis will, therefore, not bear any strict examination. It is neither adequate to the production of such effects, nor accordant with the actual phenomena of the trade-winds. It casts a false glare over the subject, without elucidating its real bearings.

True Theory.

The first who succeeded in taking a correct view of the question was George Hadley, in a short paper inserted in the *Philosophical Transactions* for 1735. By combining in some measure the idea of Des Cartes with the opinion of Halley, he produced a clear and simple account of the cause of trade-winds, which appears entirely consistent and free from every objection. Though the daily variation of temperature be very inconsiderable within the tropics, yet the annual accumulation of heat renders the equatorial regions much warmer than the higher latitudes, and consequently maintains a perpetual current of air from either side. If those aërial motions were not modified by the figure and rotation of the globe, there would always be two opposite winds blowing directly from the north and from the south to the equator. But the stream which perhaps originates at the northern tropic, in advancing to the equator, must seem gradually to deflect towards the west, in consequence of the increasing velocity with which the successive parallels of latitude are carried eastwards. During the time this current takes to perform its journey, it is apparently transported to the west, through a space equal to the excess of the arc described by the equator above the corresponding arc traced by the tropic. The current from the southern tropic is equally bent towards the west. When both of them meet at the equator, their opposite impulsions from the north and the south are extinguished, and they flow directly west in a single united stream, and with accumulated force. The apparent motions of the different streamlets which from both hemispheres conspire to constitute the trade-wind, is represented in Fig. 18, Plate XCVII.

Its Detail

But it is not enough to connect the general facts; a complete theory should harmonize all the subordinate details. An easy calculation accordingly is conducted to those precise results which are commensurate and exactly congruous with the actual phenomena. The trade-wind may be reckoned to begin about the latitude of 25 degrees. At this parallel, the mean temperature is four centesimal degrees colder than immediately under the equator, which difference of heat may graduate through the atmosphere to the altitude of 10,000 feet. Wherefore the expansion of the air at the equator which draws to it a meridional wind, will amount to a column of 100 feet. The velocity of the current hence produced must be $8\sqrt{100}$, or 80 feet every second, which corresponds to 54 miles in the hour. But each point on the parallel of 24° is carried eastwards by its revolution about the earth's axis 7 miles faster every hour than on the parallel of 25°. Consequently, when the wind arrives at the parallel of 24°, it will seem to have acquired a tendency of 7 miles an hour to the west. As it reaches the successive parallels of 23°, 22°, 21°, &c. it will gain continual, though decreasing, additions to its apparent westerly course, which at the equator will have augmented to 104 miles in the hour.

In this calculation, we have made no deduction for the resistance which the streams of air must experience in sweeping over the surface of the globe, because no experiments have been made to ascertain the effect of such retardation. It is no doubt less on the ocean than on the land, and must evidently be diminished in proportion to the depth of the mass of fluid which is borne along. Still, however, this obstruction, joined to this impediment of internal motion, must be very considerable; and we may safely reduce the numbers before stated to one-third, which would give 18 miles an hour for the celerity of the primary meridional wind, and 35 miles for that of the oriental or trade-wind, resulting from the influence of the figure and rotation of the earth.

Meteorology.

Our northern hemisphere presenting to the action of the solar beams a larger surface of land than the southern, is, on the whole, rather warmer. Hence the parallel of greatest heat runs not exactly through the equator, but about three degrees farther north. This circle is therefore strictly the mean path of the aggregate easterly streams of air.

But though the hottest part within the torrid zone, taking the average of a whole year, occupies the parallel of three degrees north latitude, it must to a certain extent shift its position with the seasons. In the summer months, the sun shines twice vertical upon the tropic of Cancer, and consequently raises the temperature of the northern half of the zone. During winter again, this effect is transferred to the southern half of the torrid region. In the progress of summer, therefore, the trade-wind gradually bends about a point towards the north; but as winter advances, it declines as much to the south.

Such is the character of that general wind which encircles the globe, flowing with slight deviation constantly from the east, and spreading over a zone of more than 50 degrees in breadth. It sweeps the Atlantic Ocean from the coast of Africa to Brazil, and the Pacific from Panama to the Philippine Isles and New Holland, and again the Indian seas partially fom Sumatra to Zanguebar.

Monsoons.

The trade-wind undergoes an essential modification, however, where the continent stretches into the torrid zone. The sun acting more powerfully upon the land than upon the surface of the sea, the accumulated warmth is much greater, and shifts with the revolution of the seasons on either side of the equator. The centre of heat approaches in summer to the northern, and in winter to the southern tropic. Instead of the great eastern stream, those regions have two opposite periodic winds alternating towards the north and the south, and called the *monsoons*. When these winds advance to the equator, they conjoin an apparent easterly velocity; but when they recede from the equator, they carry their excess of velocity from the west. A diagonal motion results from the combined tendencies. In the Arabian and Indian seas, on the north side of the equator, the monsoon blows north-west during the summer months, from April to October; and in the opposite direction, or south-east, during the winter. But on the south side of the equator, near Java and Sumatra, the course of the monsoon is north-east in summer, and south-west in winter.

The primary winds which blow from the parallels of 25 or 30 degrees to the equator, must evidently give rise to opposite currents that flow in the higher atmosphere towards the poles. These streams, after they have travelled beyond the tropics, may descend to the surface, transporting the celerity of equatorial rotation. They will appear, therefore, to blow from the western quarter, with the excess of their previous velocity above that of the parallel which they reach. Hence a westerly breeze, of considerable force and regularity, prevails in either hemisphere above the latitude of 30 degrees. The same winds cross the Atlantic from Newfoundland to Cornwall, and traverse the Southern Ocean from the Plata to the Cape of Good Hope, and thence to New Holland. Any wind which blows from the quarter inclining to the south of the west comes really from the equatorial region, and is therefore relatively warm. Such is the disposition of our westerly winds, which commonly prevail for nine months in the year.

On the same principle, a wind which blows directly from the arctic pole, and impregnated with intense cold, must, in consequence of the rotation of the globe, appear to arrive from some point to the north of the east. In passing through the first degree of latitude, it will suffer a deflection of 18 miles in the hour towards the west; in a short space, therefore, it will seem to flow with impetuous force, and almost directly from the east. Hence our easterly and north-easterly winds have a polar origin, and are always bitterly cold.

Local Winds.

Local winds could be explained, if the different circumstances which affect them were distinctly known. The latitude and temperature of the place —its relative position—the figure and contour of the surrounding country—would all enter into the calculation. We shall content ourselves with a concise notice of some peculiar winds. The *Bize* is a cold piercing wind, which blows from the ridge of the Jura, and the frozen summits of the Pyrennees. The *Sirocco* is a hot, moist, and relaxing wind, which visits Naples and the south of Italy, from the opposite shores of the Mediterranean. The *Harmattan* seems to be a cold and dry wind, of a very parching quality, which is frequent in Africa and some of the eastern countries. The *Samiel*, or *Simoom*, is a burning pestilential blast, extremely arid, which springs up at times in the vast desarts of Arabia, and rushes with tremendous fury, involving whole pillars of sand.

Theory of Clouds.

II. Clouds.—Their formation and dissolution produce all the varied train of the meteorological phenomena. The humidity suspended in the atmosphere is derived by exhalation partly from the land, but ultimately from the vast expanse of the ocean. A surface of lake, of pasture, corn-fields or forest, supports a continual evaporation, augmented only by the dryness of the air, and the rapidity of its successive contacts. Even ploughed land will supply nearly as much moisture to the exhaling fluid as an equal sheet of water. It is only when the ground has become quite parched, that it obstinately retains its latent store.

If the whole of the waters, which fall from the heavens, were to return again, the evaporation from the ground might be sufficient alone to maintain the perpetual circulation. But more than one-third of all the rains and melted snows are carried by the rivers into the ocean, which must hence restore this continued waste. The commerce of land and sea is thus a necessary part of the economy of nature.

The air, in exhaling its watery store, is rendered quite damp; but it may afterwards become dry, on being transported to a warmer situation. Such is the case of the sea breeze, particularly in summer. It arrives on the shore, cold and moist; but as it advances into the interior of the continent, it grows milder and drier. The same principle accounts for the disposition of different winds in respect to humidity. At Colombo, in the island of Ceylon, as we gather from some remarks of Dr Davy, the north-

east monsoon, with a temperature of only 68 on Fahrenheit's scale, has yet a dryness of 75 hygrometric degrees; but the opposite monsoon, from the south-west, though at 82 by the thermometer, is so damp as to indicate scarcely 30 degrees. The cold wind, coming from the north, was rendered warmer and drier in its progress; while the hot wind, flowing from the equator, was somewhat chilled and made damper as it approached Ceylon.

Since air in mounting upwards has its capacity for heat enlarged, and becomes colder, it will hence likewise grow proportionally damper. But a continual intercourse being maintained between the lower and the higher atmosphere, the middle region must, from its chillness, be soon charged with moisture. If this tendency were to act, therefore, without control, the heavens would have been shrowded with perpetual clouds and darkness, and never could the cheering rays of the sun have visited the surface of the earth. A principle of conservation happily occurs to restrain, and finally to overpower the effect of cold, in disposing air to part with its moisture. By expansion, this fluid is made capable of holding, at the same temperature, a larger share of humidity. Each portion of air, in rising vertically, grows, from the predominance of cold, constantly damper; but after having reached a certain altitude, it again becomes gradually drier, from the influence of its wide dilatation. Every time the air has its volume doubled, it acquires an additional dryness corresponding to 50 hygrometric degrees. Hence one degree would be the effect of the rarefaction of only the 72d part. This small variation again answers to a depressed temperature of $1\frac{1}{3}$ on the centesimal scale, which, near the surface, will occasion an increase of humidity equal to the actual range of the solvent power of the air divided by 31.4. Suppose the thermometer to mark 15° centesimal at the ground, the air would, for each ascent of about 390 feet, be $\frac{200}{31.4}$, or 8 hygrometric degrees damper, which would be reduced to 7° by the influence of dilatation. Had the temperature at the surface been as low as—25°, which answers to a solvent power of $31\frac{1}{2}$°, the opposite agencies of cold and rarefaction would evidently have produced a perfect balance, and the same dryness would have continued to a moderate height.

Their Mean Height.

It would be easy to show that d, expressing the density of the air at any altitude, and h the corresponding indication of the hygrometer, $\frac{h}{62.8}\left(\frac{1}{d}+d\right)$ will denote the increment of humidity occasioned by depressed temperature, while the corresponding decrement resulting from expansion is one degree. Hence at the pole the position of the *maximum* humidity in the atmosphere must occur at an elevation of 13,300 feet; where the density is .6, the temperature would stand at 26.7°, and the hygrometric range only 29°. Under the equator, that limit would attain a much greater altitude, and yet not rise so far above the curve of perpetual congelation. It is probable, however, that the canopy of clouds descends considerably lower, being warmed by the hot pulses darted from the ground and the inferior strata of the atmosphere. We shall not err much, if we estimate the position of extreme humidity at the height of two miles at the pole, and four miles and a half under the equator, or a mile and a half beyond the limit of congelation. This range is represented in Fig. 18, Plate XCVII. running nearly parallel to the curve of perpetual congelation, but bending nearer in approaching the equatorial parts. It marks the mean height of the clouds in different latitudes, and intimates the shading into the fine etherial expanse.

Modification of Clouds.

The moisture deposited by a body of air in minute globules, which remain suspended or subside slowly in the atmosphere, constitutes a *Cloud*. When it comes near us, whether it hovers on the tops of the hills, or spreads over the vallies, it receives the name of a *Fog*. The cold occasioned by the ascent, or transfer of air, may be sufficient to form thin clouds, but a more powerful and extended energy is required for the production of *Rain*. The subject has from the earliest times engaged the attention of philosophers, who have made numerous unavailing attempts to explain it. At length, the very ingenious Dr James Hutton subjected the problem to a correct analysis, and succeeded in deducing a most satisfactory solution. His fine *Theory of Rain*, which first appeared in the *Transactions of the Royal Society of Edinburgh* for the year 1787, constitutes an epoch in meteorological science. Its merits, however, have been slowly perceived by the public, because the author, full of his original conception, satisfied himself with merely sketching the general outline. But it was not enough that the operation of the principle advanced should always cause rain; it was farther requisite, that the results arising from its application should quite accord with the actual phenomena. We shall, therefore, endeavour to render this theory more definite, and more complete.

Hutton's Theory of Rain.

Air in cooling becomes ready, we have seen, to part with its moisture. But how is it cooled in the free atmosphere, unless by the contact or commixture of a colder portion of the same fluid? Now, the portion of the air which is chilled must in an equal degree warm the other. If, in consequence of this mutual change of condition, the former be disposed to resign its moisture, the latter is more inclined to retain it; and, consequently, if such opposite effects were balanced, there could, on the whole, be no precipitation of humidity whatever. The separation of moisture, on the mixing of two masses of damp air at different temperatures, would therefore prove, that the dissolving power of air suffers more diminution from losing part of the combined heat, than it acquires augmentation from gaining an equal measure of it; and, consequently, this power must. under equal accessions of heat, increase more slowly at first than it does afterwards, thus advancing always with accumulated celerity.

Illustrations.

The quantity of moisture which air can hold thus increases in a much faster ratio than its temperature. This great principle in the economy of nature was traced by Dr Hutton from indirect experience. It is the simplest of the accelerating kind, and perfectly agrees with the law of solution, which the hygrometer has established. Suppose equal bulks of air in a

Meteorology.

state of saturation, and at the different temperatures of 15 and 45 centesimal degrees, were intermixed, the compound arising from such union will evidently have the mean temperature of 30°. But since, at these temperatures, the one portion held 200 parts of humidity, and the other 800, the aggregate must contain 1000 parts, or either half of it 500; at the mean or resulting temperature, however, this portion could only suspend 400 parts of humidity, and, consequently, the difference, or 100 parts, amounting to the two hundredth part of the whole weight of air, must be precipitated from the compound mass.

As another illustration, let air of 15° be mixed with air at the temperature of 35°, in three different proportions, all at the point of saturation; one part being combined with three parts, two with two, and three with one. The temperatures arising from the commixture would be 20°, 25°, and 30°; the corresponding parts of moisture precipitated from the mass being derived from the intermediate proportions of 200 and 504, are 352—317.5, or 34.5, 276—252 or 24, 352—317.5 or 34.5, and 428—400 or 28. Those depositions are represented in Fig. 8, Plate XCVII. by the several intervals between the logarithmic curve and the oblique line which connects the summits of the ordinates of 15° and 35°.

In these examples we have assumed the portions of differently heated air to be quite charged with moisture before mixing; but it is only required that they should approach to the point of humidity. The effect, however, of simple commixture would, in most cases, be very small. To explain the actual phenomena, we must have recourse to the mutual operation of a chill and of a warm current, driving swiftly in opposite directions, and continually mixing and changing their conterminous surfaces. By this rapidity, a larger volume of the fluid is brought into contact in a given time. Suppose, for instance, the one current to have a temperature of 50, and the other that of 70 degrees, by Fahrenheit's scale; the blending surfaces will, therefore, assume the mean temperature of 60°. Consequently, the two streams throw together 200 and 334.2 parts of moisture, making 567.1 parts for the compound, which, at its actual temperature, can hold only 258.6 parts; the difference, or 8.6 parts, forms the measure of precipitation, corresponding to the 2325th of the whole weight of the commixed air. It would thus require a column of air 30 miles in length to furnish, over a given spot, and in the space of an hour, a deposit of moisture equal to the height of an inch. If the sum of the opposite velocities amounted to 60 miles an hour, and the intermingling influence extended but to a quarter of an inch at the grazing surfaces, there would still, on this supposition, be produced in the same time a fall of rain reaching to half an inch in altitude.

These quantities come within the limits of probability, and agree sufficiently with experience and observation. But in the higher temperatures, though the difference of the heat between the opposite strata of air should remain the same, the measure of aqueous precipitation is greatly increased. Thus, while the mixing of equal masses of air, at the temperatures of 40° and 60°, is only 6.6, that from a like mixture at 80° and 100° amounts to 19°. This result is entirely conformable to observation, for showers are most copious during hot weather and in the tropical climates.

The quantity of moisture precipitated from the atmosphere thus depends on a variety of circumstances,—on the previous dampness of the commixed portions of the fluid,—their difference of heat,—the elevation of their mean temperature,—and the extent of the combination which takes place. When this deposition is slow, the very minute aqueous globules remain suspended, and form clouds; but if it be rapid and copious, those particles conglomerate, and produce, according to the state of the medium with regard to heat, rain, hail, or snow.

Velocity the fall of them.

The profuse precipitation of humidity is caused by a rapid commixture of opposite strata. The action of swift contending currents in the atmosphere brings quickly into mutual contact vast fields of air over a given spot. The separation of moisture is hence proportionally copious. In temperate weather, this deposition forms rain; but, in the cold season, the aqueous globules, freezing in the mid-air into icy spiculæ, which collect in their slow descent, become converted into flakes of snow. Hail is formed under different circumstances, and generally in sudden alternations of the fine season, the drops of rain being congealed during their fall, by passing through a lower stratum of dry and cold air.

The drops of rain vary in their size perhaps from the twenty-fifth to a quarter of an inch in diameter. In parting from the clouds, they precipitate their descent till the increasing resistance opposed by the air becomes equal to their weight, when they continue to fall with an uniform velocity. This acquired or *terminal* velocity is therefore in the subduplicate ratio of the diameters of the aqueous globules. A thunder shower hence pours down much faster than a drizzling rain. In general, if d express the diameter of a drop in parts of an inch, the terminal velocity, according to theory, will be denoted by $78\sqrt{d}$, or if the usual correction be made for the discrepancy in fluids, it will be $67\sqrt{d}$. Thus a drop of the twenty-fifth part of an inch, in falling through the air, would only gain a celerity of $11\frac{1}{2}$ feet, and while one of a quarter of an inch would acquire a celerity of $33\frac{1}{2}$ feet. A flake of snow being perhaps nine times more expanded than water, would descend thrice as slow. But hail-stones are often of considerable dimensions, exceeding sometimes the length of an inch. They may hence fall with a velocity of 70 feet each second, or at the rate of about 50 miles in the hour. Striking the ground with such impetuous force, it is easy to conceive the extensive injury which a hail shower may occasion in the hotter climates. The destructive power of those missiles in stripping and tearing the fruits and foliage, increases besides in a faster ratio than the momentum, and may be estimated by the square of their velocity multiplied into mass. This fatal energy is hence as the fourth power of the diameter of the hail-stone.

III. Optical Phenomena.—It remains for us to explain the general optical appearances of the sky. When the rays of the sun strike upon a

cloud, they are copiously reflected, but partly absorbed by the minute suspended globules. In working their progress through the mass of vapour, they suffer a great diminution from the multiplied acts of absorption. The quantity of light thus finally detained depends on the density of the clouds and its thickness. But the portion which penetrates through the nebulous medium is always much less than what traverses an equal body of air. In extreme cases, perhaps, the solar beams will suffer greater defalcation by repeated repercussions within a congregated cloud, than from passing through fifty times the same extent of a clear aërial expanse. Hence such clouds always appear dark and black by their scanty transmitted light. Whiteness being produced by the copious emission of intermingled rays, can belong only to very thin clouds. The depth of shade indicates the mass of floating vapour.

Rainbows.

Owing to the excessive minuteness of the aqueous globules, the particles of light are only reflected or absorbed at their external surface, without entering them. But when they collect into large drops, the luminous pencil which strikes at a certain angle, converges by refraction to a point of the posterior surface, and after suffering one or more interior reflections, it emerges dissected into its primitive colours. Hence the glorious vision of the rainbow, which was reduced to mathematical calculation by Des Cartes, but only received its complete explication from the optical discoveries of Newton. The phenomena occur whenever the sun shines upon the falling drops of rain behind the spectator, the coloured arch being a portion of circle, whose centre is a point in the sky directly opposite to the sun. The primary or interior bow is formed by a single reflexion, and lies 45° beyond that centre; but the secondary or superior bow, produced by a double reflexion, appears with inverted tints at the distance of 56°. A ternary bow may exist, but being so extremely faint from the repeated reflexions, it is scarcely ever perceived. It hence follows, that rainbows are only visible when the altitude of the sun is below 45° and 56°. In summer, accordingly, they are not seen in this climate about the middle of the day. For the same reason, they generally appear less than a semicircle; but viewed from the top of a spire, or any lofty pinnacle, they embrace nearly the whole circumference. Lunar rainbows may be frequently observed, only the faintness of their colours makes them far less conspicuous.

Halos.

The coloured rings or *halos* which are often seen surrounding the moon and sun, are evidently occasioned by very thin vapour diffused through the atmosphere. They are supposed chiefly to encircle the moon; but, in this climate, hardly a day passes with light fleckered clouds, when at least portions of halos may not be perceived near the sun. It is only necessary to remove the glare of light which makes the delicate colours appear white. Thus, if we examine the reflexion from a smooth surface of water, we shall perceive that the sun gilds the fleecy clouds with segments of beautiful coloured rings. This effect is still more distinctly seen, if the rays from a hazy or mottled sky be received upon a sheet of white paper, held before a small hole in the window-shutter of a dark room. But even when the sun shines from an azure firmament, circles of the richest tints may be produced by experiment.

Their Origin.

Holding a hot poker below, and a little before the small hole of the shutter, throw a few drops of water upon, and the sun will be painted on the paper like the glowing radiations of the *passion flower*. The appearance is exactly similar to what the traveller, in awakening from a short slumber, perceives, in a winter's morning, on opening his wearied eyes to a burning candle—concentric rings of violet, green, yellow, and red.

The explication formerly given of the cause of halos, even that proposed by Newton himself, is inadmissible—since it would confine them, like the rainbows, to certain definite limits, whereas they appear with every possible degree of extension. Our earliest inquiries led us to refer the origin of halos to the *deflexion* of light, or that property of the rays to bend and divide as they pass near the edge of a body. Thus the light admitted through a very narrow slit in a card, or a bit of tinfoil, spreads into bright coloured fringes. The finer also is the slit, the broader are the fringes. A similar appearance is obtained by looking at the elongated flame of a candle through the delicate fibres of a feather, or even through the streaks of grease rubbed by the finger along a piece of glass. But if a very small round hole be substituted for the slit, the fringes will change into coloured rings. Thus, if a piece of tinfoil, punctured with the point of a needle, be held close to the eye, the sun will appear through it surrounded by a halo very near his disc, but spreading more in proportion as the hole is contracted. That ingenious artist, Mr Troughton, constructed for us a slide of brass, and afterwards another of platina, perforated with a series of the finest conical holes, which were measured by his delicate micrometer. The purpose was to compare the angle subtended by the coloured ring, with the diameter of the perforation, it being inferred that an aqueous globule of the same dimension might, by the exterior deflexion of the solar rays, produce a similar halo. But our variable sky is very seldom fit for any refined optical experiment, and many delays happening to intervene, we could arrive at no very precise or certain result. We may state, however, as at least an approximation, that the globules of the diffuse vapour which occasions the appearance of coloured circles about the sun and moon, vary from the 5000th to the 50,000th part of an inch in diameter. When the halo approaches nearest to the luminous body, the largest globules are floating, and therefore the atmosphere is surcharged with humidity. Hence the justness of the vulgar remark, that a dense halo close to the moon portends rain.

Nearly the same theory has been struck out by Dr Thomas Young, to whose profound ingenuity, and most extensive information, we are glad to bear honourable testimony. By a skilful application of the principle of deflected light, he has likewise constructed the *Eriometer*, a curious instrument for measuring the size of the fibres of wool and other filamentous substances. But we cannot at present enter into the details.

Eriometer.

Parhelia

The same acute philosopher has given perhaps the only true account of the origin of the *parhelia* or *mock-suns*, which are frequently seen in the arctic regions during certain dispositions of the atmosphere. This gorgeous appearance of intersecting luminous arches, studded with opposite and transverse images of the sun, he ascribes to the combined reflexions of the rays from the natural facets of the snowy *spiculæ* floating abundantly in the air. We cannot develope this theory, however, without some discussion and the help of diagrams. It may claim our attention afterwards, if Captain Parry's return from the north shall bring us more definite information.

Phenomena of irregular Horizontal Refraction with Extreme Obliquity.

Another most remarkable optical deception occurs in a peculiar state of the atmosphere on the verge of the horizon in various countries, and especially in the warmer climates, whether on the level plains, or on the margin of rivers or lakes, and near the sea-shore. In such situations the remote objects often appear with extraordinary elevation, and in double or inverted images. This singular phenomenon is obviously caused by the irregular refractions which the rays of light occasionally suffer by passing through the different strata of the lower atmosphere. When the effect is confined to the apparent elevation of an object, our seamen call it *looming;* but if inverted images be formed, the French and Italians give to this play of vision the appellations of *mirage* and *fata morgana*. The shipping and range of buildings on the shore of Naples have from Messina sometimes appeared floating inverted in the air. In the autumn of 1798, the coast of France was distinctly seen raised above the sea, from the beach of Hastings; the appearance lasted about an hour, and then sunk beneath the horizon. In the following year, Professor Vince watched the phenomena at Ramsgate with a large telescope. On the afternoon of the 1st of August he first descried the sails of a ship, but as she came fuller in view, he perceived another inverted image just below the surface of the water. Fig. 16, Plate XCVII. represents the successive appearances: A is the ship when first observed, B after she had approached, and C the inverted image. Fig. 17 exhibits a variation of the effect; A marks the ship entering the horizon, C and B the double image of the ships when near, a portion of the sea lying between their opposite traces. To produce the appearances now represented, it was requisite that the rays of light, in traversing the lower strata of the air, should describe curves, whose final tangents point in the visual directions of the objects. These curves or trajectories are delineated in fig. 13, where E marks the place of the observer, *zb* the horizon, *b* the hull, and *a* the mast of the ship; the lowest image is formed by the curves *bs* E and *at* E, above this the curves *bv* E and *au* E give an inverted image, and the curves *bn* E and *am* E exhibit the highest erect image.

Observations of Vince

In ordinary cases, a ray of light, in crossing different layers of the atmosphere, describes a trajectory, which is nearly the portion of a circle, having six times the diameter of the earth. The rate of inflexion is proportional to the tangent of obliquity, and to the difference of the refractive power of the conterminous strata, which may be assumed as the same as their difference of density. This variation in a stratum of air 28 feet thick is only the thousandth part of the whole refraction, and is hence equal to the effect of the quarter of a centesimal degree. But since a much greater difference of heat often occurs within that limit, the incurvation of the trajectory must be proportionally increased. Humidity, by dilating the air, will produce a similar effect, though in a much inferior degree, unless in very high temperatures.

Experiments of Wollaston

Dr W. H. Wollaston, whose acuteness in devising philosophical experiments is unrivalled, has been able to exhibit on a small scale the various appearances occasioned by irregular atmospheric refraction. His paper inserted in the *Philosophical Transactions* for 1800, contains a very clear exposition of the phenomena. On looking lengthwise over the side of a red-hot poker at a distant object, besides the ordinary image, another inverted one was seen within the edge of the streaming air, and a larger erect one still nearer the poker, as represented in Fig. 14. The deviation was here only half a degree, but along a red-hot bar of iron, the separation of the images was increased to a degree and a quarter. On directing the eye over the surface of a green board, which had been heated by exposure to sun, a double image was distinctly seen. Another board, merely wetted with water, betrayed a similar disposition, though it was very difficult to distinguish the irregular image, its elevation being only 3′. But on moistening the surface of the board with alcohol, the images were easily seen at a separation of 15′. Still more conspicuous was the appearance on spreading a little æther over a plate of glass, for the irregular image showed itself $7\frac{1}{2}$′ raised.

His Illustration.

It was easy to imitate and examine the natural phenomena, by means of a square parallelopiped composed of plate glass. Having filled the half of this with cold water, let hot water be gently poured over it, and the cover placed upon the top. (See Fig. 15, Plate XCVII.) On standing a few feet behind the parallelopiped, and looking at distant objects through the stratum where the cold and hot water have become blended, the double and inverted images will for a short time be clearly perceived. But a more durable effect is obtained, by filling one-third of the glass case, as represented in fig. 15, with syrup, or a strong solution of white sugar, another third with distilled water, and the rest with pure alcohol. A mutual penetration slowly takes place between the conterminous surfaces of the alcohol A and the water B, and between this and the syrup C; and after the lapse of perhaps two or three days, the blending spaces become sufficiently broad for observation. The appearances then are nearly such as those that have been sketched in the plate.

His Explication.

This mode of experiment is at once simple and convincing. The theory which Dr Wollaston draws from it is equally ingenious, but not so demonstratively established as its author presumes. It rests chiefly on the supposition, that the stratum occupied by the penetration of two fluids of different densities, graduates in refractive intensity more slowly at its boundaries, and most rapidly in the middle. Or to

borrow the elucidation of geometry, if the successive densities be denoted by ordinates, their summits will form a line of double curvature, having consequently a point of contrary flexure. This principle may be sound, though we can perceive no cogent reason why the curve of intermediate refraction should be convex or concave, or should combine both sorts of incurvation. But admitting this double curvature to be a constituent law, it will very satisfactorily explain the phenomena. The refraction will be the same, as if the light had traversed an uniform medium bounded by a surface of that reverted curvature, the convex portion diverging, and the concave portion converging the parallel rays. The different effects are exhibited in fig. 12; the distant object O is viewed in its true position by the pencil that arrives at O; it is seen inverted at I, by the rays which enter at n; the rays which fall on r make it appear again erect at A. This explication is certainly very plausible, and may probably approximate to the truth. But though much has been already achieved, the subject of irregular refraction needs to be revised and still more closely investigated.

Several interesting objects in meteorology remain to be discussed. Regarding the *Aurora Borealis*, *Luminous Arches*, and *Aerolites*, we had a variety of new remarks and calculations to offer, but we must rather abruptly close this imperfect article. In illustration of the general principles, we only subjoin descriptions of the seasons of the Arctic and Torrid Zones, from the *Edinburgh Review*, from Hamilton's *Account of Hindostan*, and from Edwards's *West Indies*.

1. *Climate of the Arctic Regions.*

"It begins to snow as early as August, and the whole ground is covered, to the depth of two or three feet, before the month of October. Along the shores and the bays, the fresh water, poured from rivulets, or drained from the thawing of former collections of snow, becomes quickly converted into solid ice. As the cold augments, the air deposits its moisture in the form of a fog, which freezes into a fine gossamer netting, or spicular icicles, dispersed through the atmosphere, and extremely minute, that might seem to pierce and excoriate the skin. The hoar frost settles profusely, in fantastic clusters, on every prominence. The whole surface of the sea steams like a limekiln; an appearance, called the *frost-smoke*, caused, as in other instances of the production of vapour, by the water's being still relatively warmer than the incumbent air. At length the dispersion of the mist, and consequent clearness of the atmosphere, announce, that the upper stratum of the sea itself has become cooled to the same standard: a sheet of ice spreads quickly over the smooth expanse, and often gains the thickness of an inch in a single night. The darkness of a prolonged winter now broods impenetrably over the frozen continent. The wretched settlers, covered with a load of bear-skins, remain crowded and immured in their hut, every chink of which they carefully stop against the piercing external cold; and, cowering about the stove or the lamp, they seek to doze away the tedious night. Their slender stock of provisions, though kept in the same apartment, is often frozen so hard, as to require to be cut with a hatchet. The whole of the inside of their hut becomes lined with a thick crust of ice; and, if they happen for an instant to open a window, the moisture of the confined air is immediately precipitated in the form of a shower of snow. As the frost continues to penetrate deeper, the rocks are heard at a distance to split with loud explosions. The sleep of death seems now to wrap up the scene in utter and oblivious ruin.

"At length the sun reappears above the horizon; but his languid beams rather betray the wide waste, than brighten the prospect. By degrees, however, the further progress of the frost is checked. In the month of May, the famished inmates venture to leave their hut, in quest of fish on the margin of the sea. As the sun acquires elevation, his power is greatly increased. The snow gradually wastes away—the ice dissolves apace—and vast fragments of it, detached from the cliffs, and undermined beneath, precipitate themselves on the shores with the noise and crash of thunder. The ocean is now unbound, and its icy dome broken up with tremendous rupture. The enormous fields of ice, thus set afloat, are, by the violence of winds and currents, again dissevered and dispersed.

"Before the end of June, the shoals of ice in the Arctic seas are commonly divided, scattered, and dissipated. But the atmosphere is then almost continually damp, and loaded with vapour. At this season of the year, a dense fog generally covers the surface of the sea, of a milder temperature, indeed, than the frost smoke, yet produced by the inversion of the same cause. The lower stratum of air, as it successively touches the colder body of water, becomes chilled, and thence disposed to deposit its moisture. Such thick fogs, with mere gleams of clear weather infesting the northern seas during the greater part of the summer, render their navigation extremely dangerous. In the course of the month of July, the superficial water is at last brought to an equilibrium of temperature with the air, and the sun now shines out with a bright and dazzling radiance. For some days before the close of the summer, such excessive heat is accumulated in the bays and sheltered spots, that the tar and pitch are sometimes melted, and run down the ship's sides."

2. *Climate of Bengal.*

"In the beginning of April, and sometimes [illegible] ber, particularly in the south-eastern quarter of Bengal, there are frequent storms of thunder, lightning, wind, and rain, from the north-west quarter, which happen more frequently towards the close of the day than at any other time. These squalls moderate the heat, and continue until the setting in of the periodical rains, which generally commence in the beginning of June. If the rains break up early in September, the weather is intensely hot, and the inhabitants, especially the European part, become very sickly. The natives, from the result of their own experience, assign six seasons to the year, each containing two months. The spring and dry season occupy four months, during which the heat progressively increases, until it becomes almost intolerable, even to those [illegible]

the country. In the middle districts it is lessened by occasional thunder-storms, named north-westers; and, in the eastern, milder showers of rain are still more frequent, and refresh the atmosphere.

"The scorched inhabitants are at length relieved by the rainy season, which in general commences nearly at the same time throughout the whole province. During the first two months the rain is heavy and continual. In this period an interval of many successive days is rare, and the rain pours with such force and perseverance, that three, four, and even five inches of water have been known to fall in a single day. In the two following months the intermissions are more frequent, and of longer duration, and the weather more sultry. The rivers, and especially the Ganges, which begin to rise even before the commencement of the rainy season, continue to increase during the two first months of it, and the Ganges reaches its greatest height in the third. The average annual fall of rain in the lower parts of Bengal is seldom short of 70, and as rarely exceeds 80 inches.

"At the approach of winter the rivers begin to decrease, the showers cease to fall, and the inundation gradually drains off and evaporates. Dew, at this season, is every where abundant and penetrating; and, in the higher latitudes of India, as well as in the mountainous tracts of it, frost and extreme cold are experienced. Even in the flat country ice is obtained by the simple artifice of assisting evaporation in porous vessels, although the atmosphere be much warmer than the freezing temperature."

3. *Climate of the West Indies.*

Seasons in Jamaica.

"The vernal season, or spring, may be said to commence with the month of May, when the foliage of the trees evidently becomes more vivid, and the parched savannas begin to change their russet hue, even previous to the first periodical rains, which are now daily expected, and generally set in about the middle of the month. These, compared with the autumnal rains, may be said to be gentle showers. They come from the south, and commonly fall every day about noon, and break up with thunder-storms, creating a bright and beautiful verdure, and a rapid and luxuriant vegetation. The thermometer at this season varies considerably, commonly falling six or eight degrees immediately after the diurnal rains; its medium height may be stated at 75°.

"After these rains have continued about a fortnight, the weather becomes dry, settled, and salutary, and the tropical summer reigns in full glory. Not a cloud is to be perceived; and the sky blazes with irresistible fierceness. For some hours, commonly between seven and ten in the morning, before the setting in of the sea-breeze or trade-wind, which at this season blows from the south east with great force and regularity until late in the evening, the heat is scarcely supportable; but, no sooner is the influence felt of this refreshing wind, than all nature revives, and the climate, in the shade, becomes not only very tolerable, but pleasant. The thermometer now varies but little in the whole twenty-four hours; its medium, near the coast, may be stated at about 80°.

"The nights at this season are transcendently beautiful. The clearness and brilliancy of the heavens, the serenity of the air, and the soft tranquillity in which nature reposes, contribute to harmonize the mind, and produce the most calm and delightful sensations. The moon too in these climates displays far greater radiance than in Europe. The smallest print is legible by her light, and in the moon's absence her function is not ill supplied by the brightness of the milky-way, and by that glorious planet Venus, which appears here like a little moon, and glitters with so refulgent a beam as to cast a shade from trees, buildings, and other objects.

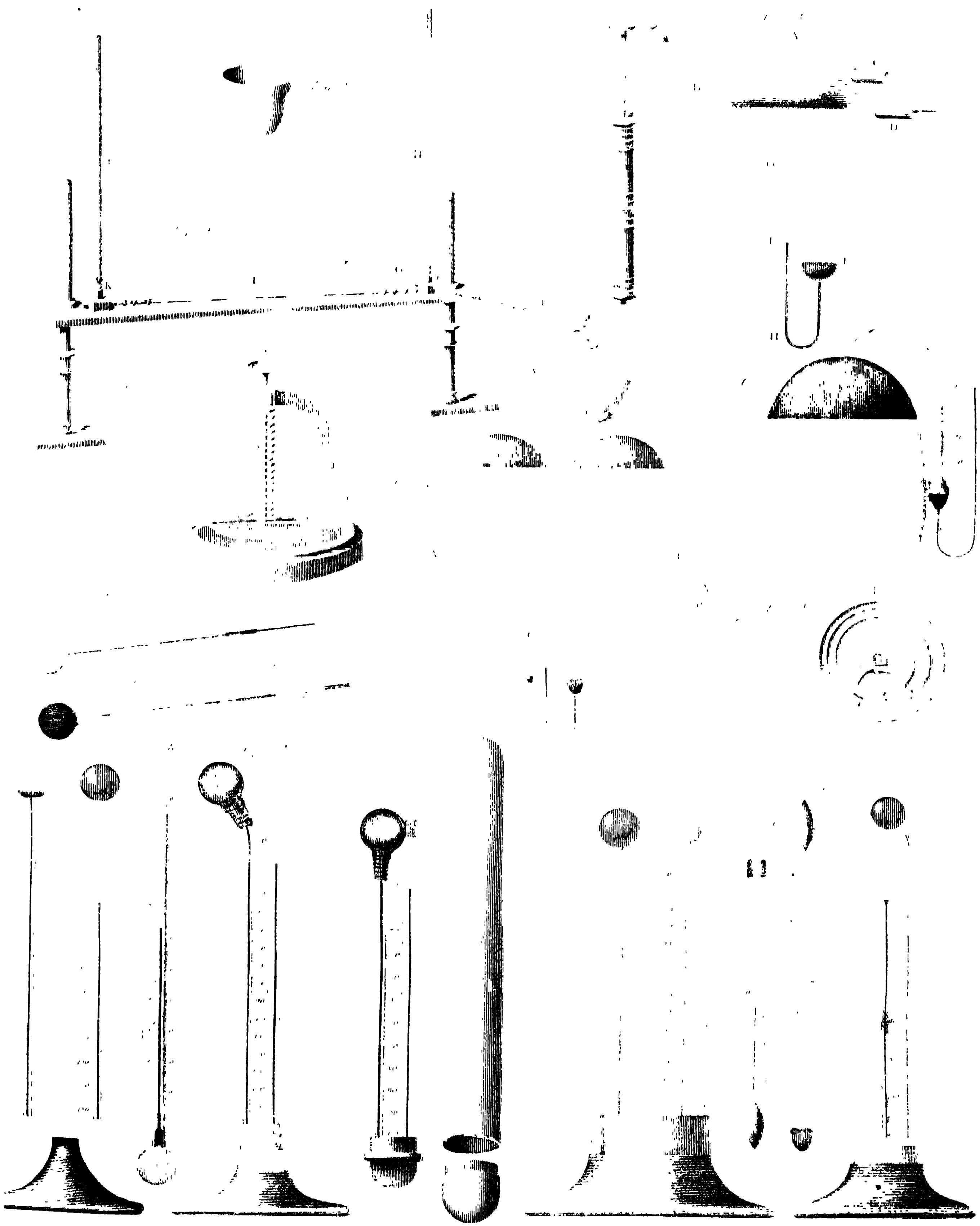
"This state of the weather commonly continues, with little variation, from the beginning of June until the middle of August, when the diurnal breeze begins to intermit, and the atmosphere becomes sultry, incommodious, and suffocating. In the latter end of this month, and most part of September, we look about in vain for coolness and comfort. The thermometer occasionally exceeds 90°, and instead of a steady and refreshing wind from the sea, there are usually faint breezes and calms alternately. These are preludes to the second periodical, or autumnal, seasons. Large towering clouds, fleecy and of a reddish hue, are now seen in the morning, in the quarters of the south and south-east; the tops of the mountains at the same time appear clear of clouds, and the objects upon them wear a bluish cast, and seem much nearer to the spectator than usual. When these vast accumulations of vapour have risen to a considerable height in the atmosphere, they commonly move horizontally towards the mountains, proclaiming their progress in deep and rolling thunder.

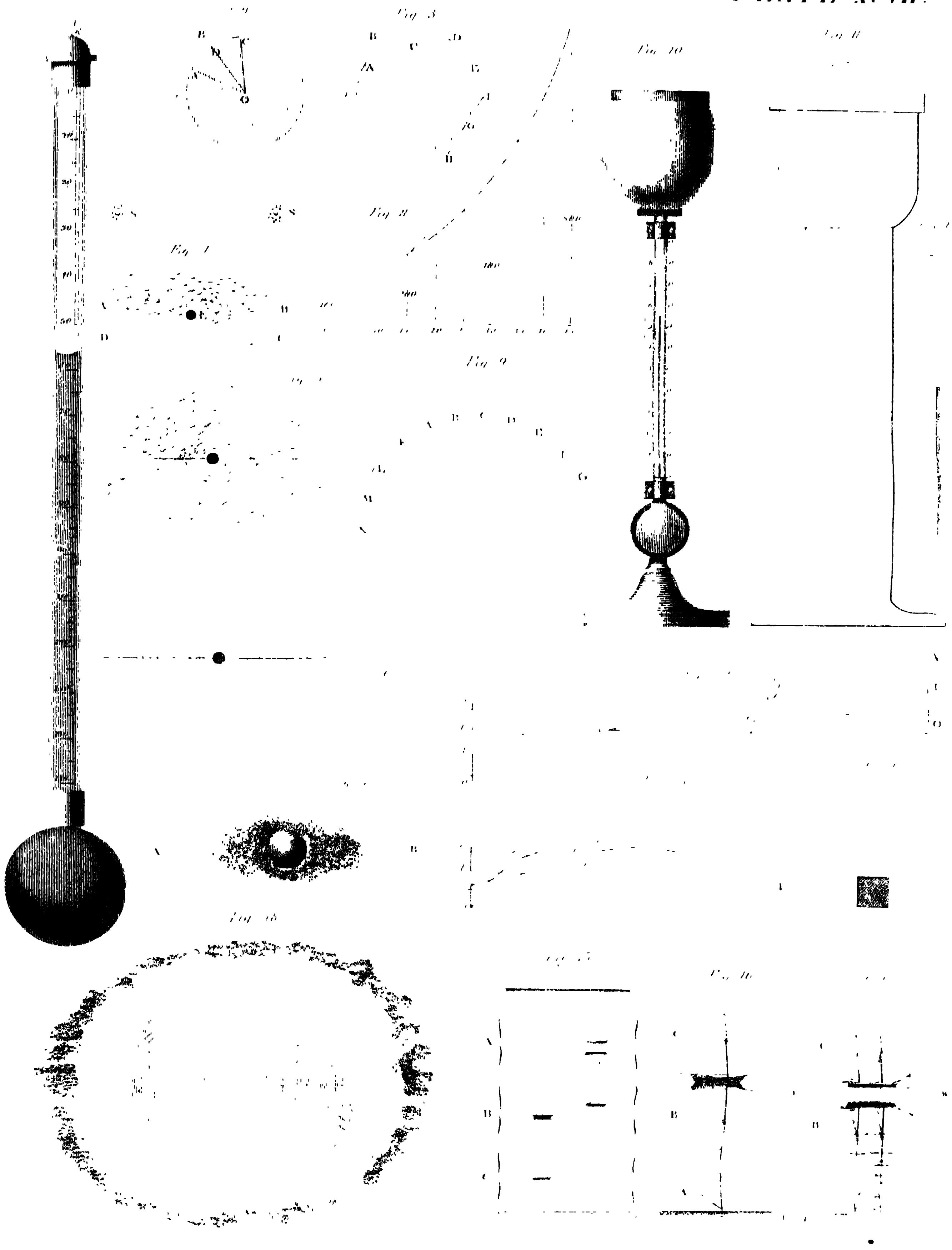
"The waters, however, with which these congregated vapours load the atmosphere, seldom fall with great and general force until the beginning of October. It is then that the heavens pour down cataracts,—and hurricanes, those dreadful visitations of the Almighty, are apprehended.

"Towards the end of November, or sometimes not till the middle of December, a considerable change in the temperature of the air is perceivable. The coasts to the northward are now beaten by a rough and heavy sea, roaring with incessant noise; the wind varies from the east to the north-east and north, sometimes driving before it, across the highest mountains, not only heavy rains but hail, till at length, the north wind having acquired sufficient force, the atmosphere is cleared; and now comes on a succession of serene and pleasant weather, the north-east and northerly winds spreading coolness and delight throughout the whole of this burning region.

"If this interval, therefore, from the beginning of December to the end of April, be called winter, it is certainly the finest winter on the globe. To valetudinarians and persons advanced in life, it is the climate of Paradise."

(D.)





MEXICO, OR NEW SPAIN.

Mexico.

As the *Encyclopædia* contains a very accurate narrative of the early history of Mexico, drawn from the best sources, we have no occasion to make any remarks on that part of this subject. We could, indeed, add but little to it, because no documents have been discovered since the period at which that abstract was drawn up, except a few hieroglyphical remains, which rather illustrate the policy, than the history of the country, under the Aztec monarchs.

New sources of information.

But the growth of Mexico since it was first subdued by Spain, its increase in population, in cultivation, and in wealth, have been laid before the public in such a luminous and authentic form by Baron Humboldt, as to merit both the attention and the gratitude of the European world. We have also been furnished with much information regarding the present state of this interesting country, of the mode in which its government is conducted, of the productions of the soil, of its facilities of improvement, and of the character and condition of its inhabitants, in the *Memorials* of the Deputies who were chosen members of the Cortes that was assembled at Cadiz. Many of them, which have been printed in Spain, give information which had escaped the notice even of the indefatigable Humboldt. The latitudes and longitudes of the most remarkable stations had not till lately been accurately ascertained, but on that subject abundant and certain documents have now been obtained. Statistical accounts of the political and territorial divisions of the population, of the revenue, the produce of the mines, the exportable surplus from agriculture, the expences of the government, the nature and number of its armed forces, and many other points, have also come to the knowledge of the European public. From these various new sources we have abstracted the view we now lay before our readers of the present condition of the most extensive community in the western world.

Extent and Boundaries.

Before delineating the boundaries of Mexico, or New Spain, it is necessary to premise, that those boundaries have been the subject of serious discussion between the crown of Spain and the government of the United States of America, though now adjusted by a recent treaty.

The eastern boundary of Mexico begins in the Bay of Honduras, and including the peninsula of Yucatan within its limits, crosses to the Lake Terminos, and then due south to Tonaloa, to the eastward of the port of Tehuantepec in the South Sea. This line divides it from the kingdom of Guatimala. From Lake Terminos, northward, the Gulf of Mexico forms the boundary to the river Mexicana, in west longitude 92° 30′, from thence it is divided from Louisiana by a line drawn through the river Sabina, till it meets the Natchitoches or Red River, in latitude 35° north; from that point, by a line to the sources of the Rio Grande, or, as it is called more usually, Rio Bravo del Norte, supposed to be in latitude 40° north. From thence its limits are an imaginary line drawn to Port San Francisco, otherwise Port Sir Francis Drake, in the Pacific Ocean, in latitude 37° 30′ north. The Pacific Ocean is the western boundary from Port San Francisco to Tonala, in the Bay of Tehuantepec, where it joins Guatimala.

Mexico

As the more extensive part of this vast country is very thinly inhabited, and almost exclusively by unreclaimed or half reclaimed Indians (though Spain may consider it among her dominions, and in her negotiations with the American States, may successfully contend for the ownership), it can scarcely be said to belong to any other power than those rude tribes, who use it, rather as hunting grounds, than as permanent occupations. If Mexico be compared with the United States, it will be found to contain nearly the same extent of peopled country. The great mass of the population, within the States, is planted on a narrow strip of land, along the shores of the Atlantic Ocean, whilst that of Mexico is concentrated principally on the table-land on which the capital is built. The exterior country of each, the northern provinces of Mexico, and the western division of the States, are alike thinly peopled, but with this material difference, in Mexico the country most thickly peopled is the most healthy, and most fertile; whilst in the States, the country but recently begun to be settled exceeds the more ancient territory, in the salubrity of climate, and productiveness of soil.

Extent, &c.

The whole surface of Mexico is nearly 120,000 square leagues, of which about one-half in extent, and by far the most considerable in every other view, is situated in what is called the Torrid Zone, though, for reasons which will appear, the climate is much cooler than in the greater part of the other half, which is placed in the temperate zone.

The most important part of Mexico is the table-land, which occupies the centre of the viceroyalty. This tract may be considered as the continuation and expansion of the ridges of mountains which are denominated the Andes, which run through the whole extent of South America, pass through Guatimala, and send forth branches to Honduras and Yucatan. After entering Mexico, it continues its course to the northward, till it terminates on the shores of the Frozen Ocean. In Mexico, however, it expands itself to a great breadth, and without deep intersecting valleys, produces an extensive plain, equal in fertility to any part of the globe, and superior in healthiness to any other between the tropics, except similarly elevated spots. The mean height of this plain is about 7000 feet above the level of the sea. The climate at that elevation is never severely cold, the snow rarely falls, and never continues on the ground, and the severest frosts that are ever felt leave no ice which remains after the break of day. The heat of summer is so tempered by nocturnal rains, and by

Mexico.

the breezes which blow almost constantly, that the weather is never so oppressively hot as to forbid travelling or labouring in the fields at day light. Though 7000 feet is the mean height of this plain, yet it abounds with elevations, some of which enter the regions of perpetual snow, and others, whose tops are covered with snow during the greater part of the year. These masses of snow communicate a refreshing coolness to the atmosphere at all times, and in the warmest seasons the melting of them produces constant streams, which communicate verdure and fertility during their course. On the eastern side of Mexico, towards Vera Cruz, the elevation is most abrupt, and when attained the most uniform. In descending from the city of Mexico to the westward towards Acapulco, the fall is more gradual, but more interrupted by irregular elevations which intervene, than to the eastward of the city. The northern side of the plain more gradually descends, and terminates at a greater distance from the medium level, than either the eastern or the western sides. It is continued to the north-east 500 miles, and to the north-west a still greater distance. A high ridge then separates one side of the viceroyalty from the other, which is scarcely passable at any point, and divides the two parts of the country as securely as an elevated wall or a fathomless cavern.

Although the table-land of Mexico is perhaps the most healthy district on the globe, yet the other parts of the viceroyalty, on the borders of the sea, partake of the ungenial properties of the torrid zone. The eastern shore is less healthy than the western. The inhabitants of the whole coast from Tabasco to the river Mexicana are subject to fluxes and intermittent and bilious fevers, which lessen the enjoyment, and shorten the duration of human life, and though the western shores are less severely, they are not less frequently visited by the same maladies.

The eastern and western access to this important plain are both attended with difficulty and fatigue. The road from Vera Cruz to Mexico, and from thence to Acapulco, are both impassable for wheel carriages; and passengers who cannot travel on foot, or endure the fatigue of horses or mules, are conveyed in litters, a kind of sedan chair, the long poles of which are fastened to the sides of two mules, one of which precedes, and the other follows the carriage. A road, however, of the most magnificent kind is now constructing from Vera Cruz to the capital; great progress has been made in it, and but for the interruption caused by the tumults which began in 1810, it would have been completed by this time: it is carrying on in some parts by the sides, in others over the tops of the mountains, and in one part it crosses a mountain 10,400 feet above the level of the sea, and 3000 feet higher than the spot on which the city of Mexico stands. Whenever this communication shall be completed, it will give a wonderful stimulus to the agriculture of Mexico, which, for want of roads to convey its surplus produce, cultivates only as much land as is required by the domestic consumption; and hence, when a year of less than usual fecundity occurs, it is exposed to great scarcity, if not to absolute famine. To the northern part of the viceroyalty, where it is of less consequence, the communication is so much better, that a coach may travel all the way from the capital to the city of Santa Fé, a distance of 440 leagues, with no interruption, and with very little risk. As the road to Acapulco is not passable for wheel carriages, those commodities which Asia furnishes to the commerce of Mexico are conveyed on the backs of mules. Rivers of great extent, and subject to frequent inundations, present obstacles which are difficult to conquer. Large sums have been destined to construct bridges over two of these rivers, the Papagallo and the Mescala, but without effect, and passengers must be conveyed across them on temporary rafts, made of reeds, which are rendered buoyant by having gourds beneath them. These rafts are guided by Indians accustomed to the business, who swim with one hand, and direct the course of the floating raft with the other.

A road has been begun from Vera Cruz to Perote, the place at which the silver and other valuable commodities are collected and deposited, till they can be conveyed to the coast. Already L.600,000 Sterling has been expended on it. The cost *per* mile is about L.7000, in a country where the labour of Indians, who are principally employed on it, does not cost one-half as much as the wages of labourers in Europe. This road is broad, solid, and of easy ascent, and equals the celebrated roads of the Simplon and Mount Cenis. Pillars of porphyry are intended to be placed along it, which will both indicate the distance and the elevation of the spot above the level of the sea.

Population.

The question of the population of this viceroyalty becomes the more interesting, from the great errors which prevailed on the subject, before the publication of Humboldt's *Political Essay on the Kingdom of New Spain*. In the *Encyclopædia* the inhabitants are estimated at 2,000,000. Pinkerton, after discussing various reports and opinions, sums up by estimating all the inhabitants of Spanish North America, including Guatimala (now known to contain more than 1,200,000), at about 3,000,000. By an actual enumeration made in 1793, in which the returns of two intendancies were made to depend on calculation, it appears that the number of inhabitants were 4,483,529; but for reasons which appear satisfactory, Humboldt contends that they amounted to 5,200,000. The Baron had peculiar advantages in forming an estimate of the population in 1803, when he was in Mexico. From the information of the clergy, whose registers of births and deaths are accurately kept; from the increase in the production of the soil, as evinced by the tithes, which are strictly exacted; and from the proportion of births to deaths, he has framed his estimate, which, if it does not arrive at accuracy, must approximate to it as nearly as the nature of the case will admit; and if it in any degree errs, it must be in under rather than in over-rating the number of inhabitants. He found the births to be to the deaths in the proportion of 170 to 100; the births to the number of inhabitants to be 1 to each 17; and the number of deaths to be 1 in 30; whilst, in France, which may be considered as the fair average of Europe, the births are to the deaths as 110 to

Mexico. 100; the births 1 to $28\frac{8}{10}$ths of all the inhabitants, and the deaths 1 to $30\frac{9}{10}$ths.

The result of his calculations give 6,500,000 as the population in 1803, being an increase of 25 in the 100 in ten years. If the same increase has continued, which there is no reason to doubt, in the year 1813 the population must have advanced to 8,150,000; from that period to the present, 1821, calculating at the increase of 15 *per cent.* for the eight years, the numbers now would exceed 10,000,000. During part of this period, great internal commotions prevailed, which must have checked the growth of the population, and therefore some allowance must be made for that circumstance. It is very difficult to calculate the effect of such wars as Mexico has entertained; because the mere loss of life forms a less important feature in the estimate, than the effect which is produced by the neglect of cultivation, and the consequent scarcity of subsistence, which tends both to destroy and to prevent life. In stating the present population of the viceroyalty at 10,000,000, we cannot be in any great error, as the introduction of the practice of vaccination must have had a tendency to correct a malady which previously produced dreadful ravages. In the year 1779, upwards of 9000 persons died of the small-pox in the capital alone, and its effects in other parts of the country were still more fatal. It is but justice to a most public-spirited individual to state, that, by the activity of Thomas Murphy, of an Irish family in Malaga, but who had taken up his residence in Vera Cruz, the virus was brought from the United States to that city, in 1804. The cow-pox appeared in its mildest form; it was communicated to all classes with facility, and even the Indians readily submitted to the operation, though they are usually too stupid to be very careful in adopting remedies to prevent evils not immediately before them. It has now spread through the whole extent of North and South America; and it is asserted that several of the most savage of the tribes have adopted it.

Classes of inhabitants. The classes into which the inhabitants of New Spain are divided is an object of great importance, when sketching a view of the country; and upon this subject the diligence of Humboldt has furnished us with ample details, which are here presented to the readers in an abridged form.

The first class is that of the Europeans, who have taken up their residence in Mexico. They are commonly there called Gachupines by the other inhabitants. They generally fill the most lucrative and honourable offices in the state, the courts of law, the boards of revenue, the church, and the army; and the greater part of the more opulent merchants are of the same class. They generally assume, even when in no official situation, nor possessed of any considerable property, a degree of importance which is by no means acceptable to those white men who are natives of the country. The Indians, however, look up to this class with great respect, and almost affection, as they see, or suppose they see, in them, protectors from the oppression which the white natives exercise towards them. The whole number of European Spaniards is not estimated at more than 100,000, the far greater part of whom are established in the capital, and the other large towns. They do not constitute more than 1-70th part of the whole population; and, in 1813, were calculated to be, to the white Americans, only as 1 to 14. They consist principally of males of mature age, the females not being more than 1 in 10 of the whole number. This greater proportion of males in the meridian of life, the stations they occupy, and the superior activity of mind which they have acquired by a European education, gives them an importance in the community very far beyond what their relative numbers alone would confer.

Creoles. The next class to the Europeans is that of the unmixed whites, natives of the country, the descendants of the first adventurers who subdued it, or of others who from time, to time, have emigrated from the European peninsula. As the Spaniards, from having so small a proportion of females, intermarry with the natives, and their offspring thus become Creoles, the disproportion between these two classes of whites is becoming greater daily. In the year 1803, they were calculated, when compared to all the other inhabitants, to be one-fifth of the whole number. They certainly multiply more rapidly than any other class, both from the greater ease of their situations, and because the mixed class, to whom we shall presently attend, are constantly falling into their ranks, and increasing their numbers. After five or six crosses between the whites and the coloured classes, the children become so nearly white, that they are easily reckoned as such; and, where doubts are entertained, the courts, upon proof being exhibited to satisfy them, decree that they are to be considered white men. It is a remarkable fact, the truth of which, however, cannot be doubted, after the pains taken by Humboldt to verify it, that the proportion of females to males is much greater among the Creoles than in any of the other gradations of Mexican population. This is clear in the villages, but not so striking as in the cities, where the proportion is 134 females to 100 males. The Creoles are possessed of almost the whole of the property in Mexico; the richest mines, the most fertile tracks of land, and the most productive plantations, are in their hands; and some of them derive revenues from their estates far exceeding those of the most opulent European nobility. The family of Valenciana, now ennobled, exclusive of the rich mine from which the title is derived, enjoyed rents amounting to more than L.90,000 *per annum*, whilst the produce of the mine, *communibus annis*, yielded a nett revenue of L.65,000. Count Regla, proprietor of the rich mine of Biscaina, built, at his own expence, two ships of the line, one of 120 guns, and presented them to the king, and lent him L.200,000, which has never been repaid, from the profits of a new seam of silver he had discovered. But the family of the Marquis of Fagoaga derived the greatest revenue, from the mine of Sombrete, that the history of mining has recorded. The nett produce, in six months, was upwards of L.800,000. Besides these and similar incomes, derived from mining, several of the Creole nobility possess estates on which no mines are worked, that are nevertheless vastly productive. The Duke of Monteleon, the lineal descendant of Cortes,

enjoys an estate, in the province of Oaxaca, worth more than L.60,000 annually, though it has recently been deprived of some branches of revenue, which have diminished it one-half. Though some enormous fortunes, acquired by mining, are transmitted to the descendants of the proprietors, yet there is greater fluctuation in this than in any other species of property. Money, rapidly gained, is generally as rapidly dispersed; and as the thirst for wealth is never satiated, those who are most successful by one mine, dissipate their riches in exploring others, whose first expence is certain and enormous, whilst the returns are frequently uncertain or trifling. It has not unfrequently happened, that the sinking of a pit, and the attendant works, has cost near L.5,000,000 Sterling, and the work been abandoned without any silver ore being discovered, or any of sufficient richness to pay the expence of separating it from the other substances that it is incorporated with. That class of Creoles who have confined themselves wholly to agricultural operations have generally secured to their families estates of increasing value, and have transmitted that uniform prosperity which neither mining nor commerce are so well fitted to secure. Though the wealth of the country is mostly in the hands of the Creoles, they are far from being all individually rich; perhaps in no class of society, in no country in the world, do the two extremes of excessive riches and excessive poverty so often meet. The pride of the Creoles, an aristocratic feeling, founded on their complexion, which gives them distinction, prevents them from pursuing those kinds of labour that are deemed degrading to gentlemen. The consequence is, that their poverty is often even greater than that of the Indians, whilst indolence, added to pride, prevents them from following any employment beyond that of the gaming table, or becoming the flatterers of the richer members of their own class. In the tremendous collisions which have recently been experienced in Mexico, the Creoles of this description have been the most energetic leaders, and have drawn into their projects many of the more rich and more successful of the white natives. Whatever of science or learning is cultivated in Mexico is almost exclusively for the benefit and improvement of this class. The University of Mexico, the Schools of Mineralogy and Chemistry, are almost solely filled by pupils from this class of society; and, as those establishments are extensive, the benefit communicated by them is gradually extending to a larger portion of the community. The greater part of the parochial, and some of the dignified clergy, are prepared for their functions from among the Creoles: some few have filled the episcopal chairs, and some who have followed the profession of law have attained to the dignity of members of the royal audience.

Unmixed Indians.

The Indians form the next class of the Mexican population; they are the unmixed descendants of the aboriginal inhabitants. They have generally remained on the same spots which their ancestors occupied, and have followed the occupations they pursued, with very little other change than substituting the Catholic rites in the room of the sanguinary religion that was formerly practised under their native emperors. The districts that were most populous at the time of the conquest have, at this day, the greatest proportion of Indian population, whilst in those provinces which were then occupied by savages, in a ruder state, who were mere hunters or fishers, such as New Biscay and Durango, there are scarcely any Indians now to be found. The Indians of Mexico are of a darker colour than those of South America, though they live in a climate of lower temperature. They have more beard, and more hair on other parts of the body, than those of the southern continent. They are almost all of them free from personal deformity. The hunch back, the squinting eye, and lameness in the hands or feet, are unknown among them. Among savage tribes, this exemption from personal deformity has been attributed to their erratic vocation, in which the weak would necessarily perish in their youth; but the Indians in Mexico have been stationary for three centuries; they have pursued the common agricultural labours, and in their habits resemble the cultivators of other countries. It is then, perhaps, natural to conclude, that this more perfect form of the human figure is derived from some modification in the constitution that is peculiar to the swarthy race, since it extends also to the Africans and the Asiatics. Whatever the appearance of the moral faculties of the Indians may be at present, it is impossible to estimate them with impartiality, unless we consider some of the circumstances which accompanied their subjection. At the time of the invasion by Cortes, the whole country was divided into two classes, the aristocracy and their slaves, for such was the condition of the more numerous body. Without contending that the progress of cultivation was very great among the Indians, yet from many facts which have come to our knowledge, we may assume that civilization and knowledge, as far as they had extended, were confined to the higher classes, who preserved and transmitted their acquisitions, in arithmetic, in astronomy, in architecture, and religion, by the hieroglyphical paintings, which were understood only by them. The higher classes perished almost wholly in the contest which ended in the subjugation of their country. The priests, who were the depositaries of science, who resided in colleges around the temples, and who made the astronomical observations which regulated their calendar, were exterminated by the fanaticism of their Catholic conquerors. The Spanish monks burned the hieroglyphic paintings by which knowledge had previously been transmitted from one generation to another. The people were thus plunged in ignorance, and which became so much deeper, from the missionaries being unacquainted with their language, and being therefore unable to substitute new ideas in the room of those the propagation of which they had stopped. The Indian females of the more elevated ranks were disposed to share what property they had secured, by forming alliances with the Spaniards, rather than to commit themselves with their countrymen, thus reduced to poverty and contempt. The rest of the natives consisted only of the indigent race, who, under their aristocratic countrymen, had been kept in subjection, and were in total ignorance of what little knowledge existed in

the country. They were either the cultivators, the lowest class of artisans, the porters who had been accustomed to be treated as beasts of burden, or those numerous beggars, who, when Cortes first visited the country, crowded the streets of all the great cities. The few of the chiefs that were left concealed their rank from the conquerors, and with no other decorations than the lowest of their tribe, were satisfied in receiving from them that voluntary homage which custom had long sanctioned.

It is impossible to judge what faculties may be developed in a nation by seeing only the remains of its lowest class, and those in a state of subjection and oppression. Humboldt has said of the Indians of Mexico, "I know no race of men who appear more destitute of imagination. When an Indian attains a certain degree of civilization, he displays a great faculty of apprehension, a judicious mind, a natural logic, and a partial disposition to subtilize or seize the finest differences in the comparison of objects. He reasons coolly and orderly, but never manifests that versatility of imagination, that glow of sentiment, and that creative and animating art, which characterize the nations of the south of Europe, and several tribes of African negros." The Indians generally reside in their own towns and villages, where they are governed by their chiefs, who, if the laws enacted by Spain were all obeyed in her colonies, would have the rank and privileges of Castilian nobility. It is now difficult to distinguish the chief from the others of his tribe, as they affect, in their dress and mode of living, to exhibit an appearance of poverty, under which they may, with less observation from the intendants, practise oppression on those they govern. They are the collectors of the capitation tax which is paid by the Indians, which they levy most rigidly, and at the same time extort considerable sums for their own emolument. These caciques now display the same vulgarity of manners, and the same want of civilization, as the lower Indians, and appear to excel them in nothing but that chicanery by which they extort from them a portion of their gains. The caciques being recognized as nobles, might pursue the law, or enter the army, and arrive at distinction; but few have chosen these professions; many of them, however, become priests, and the females of this cast are almost the sole occupiers of the convents.

The Indians are acknowledged by the laws to be freemen; and though, when in their own towns, they are governed by their native chiefs, and are treated as in a state of pupilage, they may leave those towns, take up their abodes where there is no cacique, and dispose of their labour to the best advantage. In this manner some families have established themselves in places not under the native governors, and have acquired considerable wealth. The great check to improvement with this race is their fondness for ardent spirits, particularly one kind, called *Pulque*, which is distilled from the Agave, with which they intoxicate themselves habitually, if they can procure it. As the price of this spirit is very low, whenever they work free from their chiefs, they can procure sufficient by labouring a small portion of their time, to indulge in drunkenness during the remainder. The tribute paid by the Indians is a poll-tax on all the males between the ages of ten and fifty. It has been frequently diminished in the last two hundred years, and now varies in different provinces of New Spain, amounting in some to one dollar annually, in others to nearly two. The Indians are, however, exempt from all other imposts, even the Alcavala, which every other subject of Spain pays on the sale of all productions. The capitation tax was intended to favour, not oppress the Indians, but by the knavery of their chiefs, probably in collusion with the white inhabitants, it is made an engine of considerable extortion. The Indians, however, pay ecclesiastical dues, which, in their narrow circumstances, press hard on them, but from their superstitious attachment to the showy ceremonies of the church, are borne with more cheerfulness than the tribute. The court of Spain, in order to benefit the Indians, have recently appointed an order of magistrates (Subdelegados), whose office it is to protect them. These were mostly chosen from the white natives, and the institution, instead of benefiting, appears to have depressed still more the unfortunate race, who endeavour, but generally in vain, to obtain redress from the extortions of the Subdelegados, by appeals to their priests, who, being often of their own race have not sufficient power to protect them against the white Creoles. The Indians consider the Creoles as their oppressors, and the Europeans as their protectors; and hence the animosity between the two classes of white inhabitants becomes inflamed, whilst the poor Indians, from the scarcity of Europeans near their villages, and from not understanding their language, can scarcely even obtain that relief which, if their complaints were made known with facility, would sometimes be administered to them. Though the Indians have appeared patient under suffering, and excessively indolent, yet when their vengeful passions have been roused, they have discovered most vehement feelings, and have shown themselves capable of strenuous exertions. The same Indian who has patiently suffered himself to be whipped at the door of the church, for some ecclesiastical offence, and has meekly thanked the reverend executioner for the correction he has administered, has appeared cunning, active, impetuous, and cruel, when acting with his brethren in the late popular disturbances. The number of unmixed Indians in the whole of New Spain may be estimated at near 3,000,000, and, by every document, it is clearly proved, that they have of late rapidly increased, though not with a rapidity equal to that which the Creoles and mixed casts have exhibited.

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The class of mixtures from the primitive races has, in process of time, become a very important portion of the population of New Spain. In a country where rank depends more on the complexion than on the endowments, which, in other countries, confer distinction, it is not surprising, that almost every shade has its limits defined by terms, which, though apparently only expressing the colour, do in reality express the rank of the individual. As the terms used frequently occur in all books relating to the Spanish colonies, an explana-

Mexico.

tion of them may not be useless. The son of a white, whether Creole or European, by an Indian female, is called *Mestizo.* His colour is almost a pure white, and his skin is of a peculiar transparency. The small hands and feet, and a certain obliquity of the eyes, are more frequent indications of the mixture of Indian blood than the nature of the hair. If a Mestisa marry a white man, the second generation scarcely differs in any thing from the European race. They are generally accounted of a more mild character than the mulattoes descended from whites and negresses, who are distinguished by the violence of their passions, and the singular volubility of their tongues. The issue of negros by Indian females bear in Mexico the singular name of *Chinos*, or *Chinese*, in common language; though by the laws they are denominated *Zambos.* The term Zambo, however, is generally applied to the descendants of a negro and female mulatto, or a negro and a female Chinese. Another gradation, called *Zambo prieto*, or blackish Zambo, is the offspring of a negro and female Zamba. From the union of a white man and a mulatto woman the class of *Quarterons* is derived. When a female Quarteron marries a white man, the children are denominated *Quinteron.* The issue of a white man by a female Quinteron is considered as white, and is elevated to the highest rank. The number of these mixed casts is generally estimated to be equal to that of the pure Indian race. They are none of them in a state of slavery, but form the class from whence the lower kinds of traders, manufacturers, servants, sailors, and labourers, are furnished. They constitute the middle and lower ranks of society, in general, though some of them rise to wealth and knowledge, and thus, by connecting themselves with those a cast whiter, prepare their offspring for the highest municipal stations. The number of negros, whether slaves or freemen, is very inconsiderable in Mexico; of the 74,000 negros which are annually drawn from Africa for the Spanish colonies, not more than 100 are landed on the shores of Mexico, and these are generally employed in the hot countries on the coast, which are equally destructive of the lives of the Indians from the interior, and the newly imported natives of Europe. But though there are few or no negro slaves in Mexico, a species of slave kidnapping is carried on, if possible more disgraceful than that on the coast of Africa. The missionary monks make incursions into the territories of those unreclaimed Indians, whom they call *Indios bravos*, because they have not, like those of the missions, *Indios reducidos*, learned to make the sign of the cross. Impelled by a mixture of fanaticism and cupidity, they surprise all they can, even old men, women, and children. The prisoners taken in this petty warfare, which is constantly carried on in the *provincias internas* on the frontiers of New Spain, are not indeed numerous. The tribe that is most commonly subject to these incursions is called Mecos. When seized, they are generally conveyed as prisoners to the house of correction in the capital, where their ferocity is often increased by solitude and despair. When conducted to Vera Cruz, Havana, or other warm climates, they speedily perish, as all the savages of the mountains do when compelled to labour in the most sultry of the tropical regions. These Mecos sometimes escape from their confinement, or their masters, and commit the most barbarous cruelties before they can be subdued. The whole system is most disgraceful, and the more from religion being made the pretext for continuing it.

Commerce.

Notwithstanding the considerable population of Mexico, and its extensive agriculture, its external commerce is but insignificant. This may arise in a great degree from the impolitic and unjust restrictions laid on it by the European metropolis, but in a greater degree from the varieties of the soil and climate, being such as to produce all that man can want; and from the population being so thinly planted as to render the value of the surplus production scarcely equal to the expence of conveyance from the place of its growth to any other place of consumption. On the eastern side of Mexico the whole external commerce is restricted to the ports of Vera Cruz, Campeche, Huasacualco, Tampico, and Santander; and if the restrictions did not legally exist, it would be almost impossible for any other port to trade to a considerable extent, from the shallowness of their water, and the obstructions of their bars. As the trade of Vera Cruz is, however, of exclusive importance, the consideration of that must be principally attended to. The harbour, if it deserves the name, is protected from all but northerly winds, by a cluster of islands which surround it, and is rather a strait between the main land and the island Gallega, on which the castle of St Juan de Uloa stands, than a secure port. The depth of water at the entrance is four fathoms, and at the moorings not more than four and a half. The ships are secured by having their cables fastened to ring-bolts fixed in the castle of St Juan. The tide rises but once in twenty-four hours, and varies from one to three feet in its rise. When a violent gale from the north occurs, the vessels are no longer safe, but must seek security by running to sea, and if the gale does not endure so long as to drive them on the shore of Campeche, when it is over they may return to their moorings. The nature of this port is an impediment to commerce, but none better has been found by which a connection with the interior can be maintained. The city of Vera Cruz is peculiarly unhealthy, and equally dreaded by the sailors from Europe and the natives of Mexico, who descend from the table-land to convey the goods to and from the shore. The merchants, too, among whom are some of very great capital, prefer residing at Xalapa, to breathing the pestiferous air of the hot region, and thus the climate, as well as the physical imperfections of the port, acts as an impediment to commerce. Considered as a single port, and viewing the circumstances of its position, the trade of Vera Cruz is enormous, but as the only point of commerce for a rich country of eight or ten millions of inhabitants, it is very small.

The importations consist principally of the superior kind of clothing which are required by the higher classes, of wine and brandy, of paper and iron. These amount together to about L.4,500,000 Sterling. Besides, there are imported from the other Spa-

nish settlements in America various articles, but principally cocoa and bees-wax, to the amount of about L.350,000, thus making the whole imports somewhat less than L.5,000,000. The exports consist almost wholly of the precious metals, of cochineal, and indigo. Some sugar is exported, and it is an increasing production, which, when the new road is completed, must be very considerably augmented. Flour has also of late been exported to the islands, especially to Cuba, and this commerce must also increase as the roads are improved.

Average Value of Exportations from Vera Cruz computed in British Sterling.

To Spain.

Cochineal, - -	L.760,000	
Indigo, - - -	725,000	
Sugar, - - -	325,000	
Gold and silver, coined and wrought, - -	3,950,000	
Various small articles, amounting together to - -	56,000	
		L.5,816,000

To the other Settlements in America.

Flour and other provisions,	L.137,000	
Gold and silver, - -	813,000	
Various small articles, amounting together to - -	80,000	
		L.1,030,000
		L.6,846,000

The commerce is carried on by about two hundred and fifty vessels of different sizes, which annually load and unload here. The greater part of the indigo, and some part of the cochineal, are the products of Guatimala, brought to Vera Cruz for the convenience of transporting to Europe. These are conveyed partly by land and partly by the river Huasacualco, and merely pass through Vera Cruz; and in estimating, the exports ought to be deducted from the amount: allowing for these one million, the whole exported productions of this vast country, independent of gold and silver, does not exceed in value in the whole year what is exported from Great Britain weekly.

Humboldt states the number of persons employed in the mines not to exceed 30,000, or one in two hundred of the whole population; the exportable produce of whose labour amounts to L.4,793,000: whilst the surplus produce of all the rest of the inhabitants does not amount to much more than one-fifth of that sum. The United States of America, with a population nearly the same as Mexico, having about as many negro slaves as New Spain has of Indians, and cultivating a less grateful soil, have been enabled to export surplus native productions to fourteen times the amount, and Great Britain, with only half as many more inhabitants, exports sixty times as much.

The commerce of Vera Cruz is under the direction of a body called the *Consulado*, consisting of the most eminent merchants. This body acts as a court of justice in all commercial affairs, which they decide with promptitude and equity, without the intervention of lawyers. As a corporation they enjoy considerable wealth, which is expended in promoting the security of the port, and in improving the roads that lead to it. For these purposes a tax is levied on all imports and exports, which is expended under their direction. The other foreign trade of Mexico, if that can be called a foreign trade which is carried on with a colony of the same sovereign, is from Acapulco in the Pacific Ocean, to Manilla. Acapulco is one of the best harbours in the world; it has two entrances, and is completely sheltered by the island at its mouth, which separates these entrances. The anchorage is good in from ten to twenty-five fathom water. Though the immediate vicinity of this port is a barren soil, and the situation at present unhealthy, yet in process of time it must become a place of considerable importance. There are few inhabitants except at the fair, which is held on the arrival of the ship from India, when both the town and the neighbouring villages are crowded with visitants. This whole trade is carried on by a single ship called the galleon. It is usually from 1200 to 1500 tons burden, and is commanded by an officer of the royal navy. It sails from Manilla the latter end of July or beginning of August, loaded with calicoes, muslins, silks, spices, drugs, and the other valuable productions of India and China. The value of this cargo is limited by law to five hundred thousand dollars, but it generally amounts to treble that sum. The merchants of Mexico and Lima are interested in the expedition; but many of the ecclesiastical corporations invest part of their funds in the speculation. The arrival of the galleon draws to Acapulco numerous purchasers, who are frequently disappointed, by finding, on their arrival, that, by a combination among some of the great capitalists of Mexico, the whole cargo has been disposed of in a single lot. The returns from Acapulco to Manilla are made almost wholly in coined silver, and amount to between one million and a million and a half of dollars. Some iron is sent, a little cochineal, oil, cocoa, and wine, but these are of small amount. Many passengers go by this annual ship to Manilla, especially the missionary monks who are destined to make proselytes on the Philippine Islands. A small portion of commerce is conducted between Acapulco and the ports of Guyaquil and Lima. The vessels from the south bring Peruvian wine, oil, copper, and cocoa, and return with a few woollen goods manufactured at Queretaro, some cochineal, and a quantity of contraband East India articles. Though this passage from south to north is easily accomplished, yet in the imperfect state of the art of navigation which is practised on the coasts of the Pacific Ocean, it generally requires more weeks to return than it does days to arrive. Acapulco, in the hands of a power with capital and industry, might command the whole of these two valuable branches of the fishery from which the English and the Anglo-Americans have derived such great advantages. The spermaceti whales are caught on the very coasts, and the black whales are abundant a few degrees to the northward; but though the Mexicans have constantly

before their eyes the benefits which their rivals draw from this source, not a single vessel has ever been equipped by them for either of these fisheries. The trade in furs on the north-west coast of America, and the conveyance of them to China, belongs to this part of the world, from whence traders would find advantages that would defy any competition from those who are obliged to coast the whole of North and South America on both sides the continent, before they can reach the station where their trade commences.

Agriculture, and its Products.

The view taken of the face of the country in New Spain must have shown that it is capable of producing all the fruits which can be found in the various climates and countries of the globe. In the account of its agriculture we must, however, enumerate and describe not what it is capable of producing, but what it actually does produce. Indian corn or maize is the most important to the natives of any aliment which is known. It is cultivated in Mexico from the warmest regions up to the height of 9000 feet above the level of the ocean. Its fecundity, in favourable years, in fertile soils, and in proper situations, is wonderful. Its increase in these circumstances has been ascertained to be from three to four hundred times the quantity of the seed that was sown. The general average of the increase is stated to be from 130 to 150 for one. When it returns no more than seventy for one, the cultivation is thought to be not worth continuing. It is used for food in a variety of ways; the green ear is boiled or roasted, and eaten in that state, when it is not unlike green pease. When ripe it is bruised to a flour for bread, or for thickening the soups of the inferior casts. It is used on the declivity of the mountains, above the height in which the sugar-cane will flourish, to make an ardent spirit, in the use of which the Indians indulge to great excess. By expressing the juice from the stalk a sugar is formed, but the sugar-cane having of late been much extended in its growth, has in a great measure superseded this application of the maize. Though maize is sometimes a most abundant crop, yet there are seasons when, in some districts, it almost wholly fails, and the inhabitants feel the severest want. The price of this grain regulates that of almost every other commodity in Mexico. When either a premature frost, or the absence of rain, destroys the harvest, both human beings and the domesticated animals suffer the severest misery. It is, however, a slight alleviation of their sufferings, that the scarcity seldom visits both the warmer and the colder regions in the same year; but the badness of the roads, and the great distance from one district to another, prevents the surplus of one part from relieving the distress of another to any effectual extent. Wheat is one of the presents which the old continent has conferred on the new. The first introduction of it into Mexico was in the year 1530, when a negro slave of Cortez found three or four grains of it among some of the rice. These were sown, and the produce distributed to be again sown, till it has become general. The highest and the lowest regions in Mexico are equally unfit for the cultivation of wheat. It is only grown in the southern provinces, at the elevation of 2650 to 4250 feet above the level of the ocean. In the more northern provinces it is produced at a lower elevation. The increase of wheat, in most parts of Europe, is calculated to be about five for one on the average of different countries; but in Mexico, at the proper elevation, it generally yields from thirty to forty for one, and at Cholula, it has exceeded seventy or eighty for one. The great impediment to the cultivation of wheat and other grains of the *cerealia* species, is the want of moisture. Long continued droughts frequently destroy the hopes of the cultivator. In no part of the world does artificial irrigation so abundantly repay the expence that is incurred; but, owing to want of skill in conducting the rivulets which the melting of the snows form, and perhaps more to the want of capital, this important operation is either omitted or negligently executed. On some farms, where the system of irrigation is followed, they water the wheat twice; first, when it shoots up in January, and again in March, when the ear begins to be formed. By leaving the land flooded for some weeks at this latter period, the tenacious soil imbibes such a quantity of moisture, as enables it to resist the deleterious effects of the long droughts, and the burning sun which it subsequently endures. In these irrigated farms, as in Egypt, the seed is sown when the flooding commences, and this is thought to destroy many of those weeds which would be injurious to the crop. The tillering of the wheat plants in Mexico, as well as the number of grains in each ear, is most astonishing. In the best lands, and in the most favourable seasons, we have seldom seen more than six or seven shoots from each root that produced ears, and those ears average from sixty to seventy grains in each. In Zelaya, a cultivator took, at random, from a field of wheat forty plants, and Humboldt found from forty to seventy stalks from each plant. The grains were counted, and were found in different ears to be from 120 to 160. The soil of the wheat lands is generally composed of tenacious clay, mixed with basaltes and amygdaloids, which, though difficult to pulverise, such land, when brought into proper culture, is best adapted for the growth of that plant. Rye and barley, as they resist a greater degree of cold than wheat, are grown on higher elevations. The produce is not much greater than on the lands of some of the best cultivators in England. Oats are scarcely cultivated in Mexico, where, as in Spain, the horses are fed on barley, though sometimes maize is used for that purpose.

Potatoes, for which Europe is indebted to America, are much cultivated in Mexico. It is not an indigenous plant, but was transported from the mountainous parts of Peru, at a very early period after the conquest of that country. It has been generally asserted, that the potatoe is a spontaneous production of the Andes, but Humboldt and his companion, Bonpland, though diligently herborizing from the fifth degree of north to the twelfth of south latitude, found none in a wild state with nutritive roots. They, however, were led to suppose, that in the Andes of Chili they are indigenous. In Mexico, they are cultivated on the highest inhabited lands. The natives preserve them for several years, by exposing them first to the frost and then to the heat of

the sun. They grow to a large size; some of them were found by Humboldt to measure from twelve to thirteen inches in diameter, and to be better tasted than any that are grown on our continent.

The banana is, to the inhabitants of warm regions, what grain is to the people of temperate and cold countries; but infinitely more beneficial, in as much as on the same portion of land, and with the same quantity of labour, a much greater quantity of nutritive sustenance may be produced. Within eight months after planting, the banana begins to form clusters, and these may be gathered in the tenth or eleventh month of their growth. When the stalk is cut, some other shoots from it, about two-thirds the height of the parent plant, are left standing, and they bear fruit in about three months after. Thus a plantation is perpetuated, without any other subsequent labour than that of cutting the stalks on which the fruit has ripened, and occasionally digging and dressing round the roots. The ripe fruit of the banana resembles, in appearance, the bean pod, but is far larger. When exposed to the sun, it is dried in the same manner as the figs of the south of Europe. The skin then becomes black, and emits a smell resembling that of a smoked ham, and in that state becomes an object of considerable internal traffic. Its taste is agreeable, and it is considered to be very wholesome, whilst the ripe fruit, in its crude state, is found difficult of digestion by newly arrived Europeans. The green fruit is frequently cut into slices and dried in the sun, and being thus rendered friable, is reduced to powder, and serves the purposes of flour in many culinary preparations. The facility with which this food is produced, gives it an advantage over every other alimentary substance in the same climate. Even the bread fruit, though it affords food through almost the whole year, may be destroyed by an enemy, and cannot be quickly reproduced, whilst the banana, if destroyed, may become available again for subsistence in a few months by planting suckers. The produce of the banana, as compared to that of wheat, is estimated as 133 to 1, and to potatoes as 44 to 1. The facility with which food can thus be obtained in the hot regions, necessarily creates great indolence in the inhabitants. With two days slight labour in each week, a man may gain sufficient subsistence to support a family; and yet such is the love of their native spots with the inhabitants of the mountains, that though a single frost may destroy the labour of the year, none of them will emigrate to the thinly inhabited plains, where nature showers her gifts with such profusion.

In the same temperature which favours the cultivation of the banana, the manioc, or cassava, is grown, and, like it, is abundantly productive of aliment. There are two kinds of manioc; one, called the sweet, may be eaten without injury, the other, the bitter, is a very active poison in its crude state; both are made into bread, but the latter is most generally used for that purpose. The root is first dried, it is then grated, and the juice carefully expressed, by which means a tolerably palatable and wholesome flour is produced. It is generally made into thin cakes, not unlike the oat-cakes eaten by the labourers in the west of Yorkshire. It has the great property of keeping a very long time, and is not liable to be attacked by worms, or the other insects which, in warm climates, are so destructive of other bread. The cultivation of the manioc requires more care than the banana, and in some measure resembles that of potatoes; the slips are planted, and in seven or eight months the harvest may be gathered.

Almost every species of fruit is produced in Mexico, and the esculent vegetables of every climate are profusely scattered; some of these are indigenous, but some of the best, as the various cabbages, the turnip, the carrot, and pease, have been introduced by the European settlers, and have multiplied till they have become as abundant as the native productions. The jealousy of Spain has prevented vines and olives from being extensively cultivated; but when they are attended to, they yield abundance of fruit. The court of Spain, instigated by the commercial jealousy of its merchants and agriculturists, has always discouraged the cultivation of the vine, the olive, the mulberry, and of hemp and flax. They are generally prohibited in the colonies; but it is difficult to execute the law with rigid strictness. Whilst Humboldt was in Mexico, an order was received from Madrid, to root out all the vines in the northern part of the viceroyalty, because the merchants of Cadiz complained that the vent for their wines and brandies had diminished; but the viceroy would not obey the order, judging that, notwithstanding the great patience of the inhabitants, they would not submit to have their property laid waste, merely to gratify the cupidity of the European monopolists.

After sketching those productions which constitute the *food* of man, we may notice those which furnish his *beverages*. The most important of these is called the Maguey, a species of cactus, or opuntia. The plants are set about five feet asunder in rows. When the head of the plant throws forth the bundle of central leaves, they are cut off, and a hole is scooped in the stalk, which is covered with the leaves. In this hollow the plant seems to deposit all the juice, which, without the excision, would go to form the flowers. It is a real vegetable spring, running for two or three months, and which may be emptied twice or thrice in the day. The plants are very productive; a single one will yield 150 quarts of honey (for so in this state it is called) annually. It is placed in a situation to ferment, an operation which takes place in a few days, when it becomes fit to drink, and is called *Pulque*. It is said in its taste to resemble cider, but has a most disgusting smell, which, for a long time, prevents Europeans from tasting it. When accustomed to it, however, people become very fond of it, and account it healthy and nutritive. The cultivation of the plant which produces this liquor is of vast importance, both to the public revenue and to the comfort of individuals. It pays a duty on its introduction to the cities, and in the year 1793, the amount of the tax produced at the gates of the cities of Mexico, Toluca, and Puebla, amounted to near L. 200,000 Sterling. By distillation of pulque, a very intoxicating kind of brandy is produced, which, though prohibited by the laws,

Mexico. in order to favour the brandies of Spain, is of very extensive consumption. The plant from which the pulque is made has other valuable purposes to which it is adapted. It is used in making ropes, and even paper; it furnishes the inhabitants with a thread, called pita; its juice is used as a caustic to wounds; and its prickles serve the Indians for needles and pins.

The soil of some parts of Mexico is admirably adapted to the cultivation of tobacco, and perhaps in no portion of the globe is the consumption of that plant greater. It has been always a subject of taxation in every part of the Spanish dominions; but, in 1764, the royal monopoly, or farming of it, was introduced to this viceroyalty. Not only is it now necessary to obtain special permission to plant tobacco, but the whole growth must be carried to the royal farm, and paid for at a price to be fixed by the head of the department. It can only be raised in a district of four or five square leagues, and revenue officers traverse the country in all directions for the purpose of rooting up all the plants that are illegally cultivated. The consequence of these impolitic regulations has naturally tended to check production; and as sufficient is not raised for the consumption, the deficiency is supplied from provinces, where the expence of obtaining it is greater.

Sugar and rum are produced in New Spain, and, as before stated, want only good means of intercourse to increase most rapidly. As the cultivation of sugar is well known, it is needless here to give a description of it; but we cannot omit the striking result of a calculation made by Humboldt, viz. that all the sugar consumed in France, amounting to about 18,000 tons, might be produced on seven leagues square of land in the equinoctial regions. Cotton is grown in Mexico, but to an extent too limited to admit of any considerable exportation; the far greater part is appropriated to domestic consumption, and the whole sent to Spain is not valued at more than L.25,000. The quantity is not sufficient to supply New Spain, and it draws what its wants require from Guatimala and New Granada. Some valuable drugs are produced in Mexico, as sarsaparilla, jalap, vanilla, snakeroot, and some others, which, however important to the healing art, are of too little consequence to the agriculture or the commerce of the country to deserve detailed notices. Of dyeing drugs indigo is produced, but in very limited quantities, and scarcely more than sufficient for the few domestic manufactories. Cochineal is, however, a product exclusively hitherto Mexican, and deserves some attention. It was certainly cultivated long before America was known to Europeans. The cultivation of cochineal is at present limited to the intendancy of Oaxaca. Not more than fifty years ago, it was produced in the province of Yucatan; but on a single night, all the nopals, on which the cochineal insect lives, were cut down, and the breed consequently exterminated. The Indians assert, that this was done by the government, to increase the price of the stock on hand, and to confine the whole growth to the province of Misteca, in Oaxaca, where it is chiefly produced. The whites, on the other hand, aver that the Indians, irritated at the low price which the merchants had fixed for cochineal, formed a combination, and destroyed at once both the insects and the plants on which they were reared. There are two species of cochineal, called *Grana fina* and *Grana silvestre*, one the wild, the other, if we may be allowed the term, the domesticated kind. The wild is found in several parts of the world, but though pains have been taken to introduce the better kind in many countries, they have hitherto been unsuccessful. The wild cochineal is covered with a cottony down, which prevents the rings on its back from being visible; the fine is distinguished by being covered with a mealy kind of white powder, which does not conceal the wrinkles on its back. Whether these two insects are of the same species is still a subject of doubt among the most acute entomologists. It is, however, certain, that they are bred on different plants, but yet it is ascertained that they couple together.

The nopal trees, on which the fine cochineal is bred, is of the cactus tribe, known by the name of the prickly tuna; but this variety has its fruit smaller, of an insipid taste, and white, instead of red. When designed to rear the cochineal insect, it is not suffered to grow to more than two feet in height. They are planted on land well cleared of weeds, and of other trees, which are usually burnt on the ground. The ground is cleaned twice in each year, and, if this be accurately executed, and the soil favourable, in the third year they become fit to rear the insects. In the months of April or May, the proprietors, called *Nopaleros,* purchase branches or joints of the *Tuna de Castillia*, with the young cochineals recently hatched upon them. These branches, though separated from their roots, preserve their moisture for several months. The Indians, who collect the young insects, keep them about three weeks, either in their huts or in caverns, where the branches to which they are attached are suspended under cover; after which they are exposed to the open air. The growth of these insects is rapid, and, in August and September, the mother cochineal have eggs not hatched, and are big with eggs a second time. Their laying continues from thirteen to fifteen days. In about four months after placing the cochineals on the nopals, the first harvest may be collected in the warmest situations, and in those a little cooler, though the insect is equally valuable, somewhat later. Much care is necessary in keeping the nopals clean, and Indian women sit down many hours to a single plant to brush them with the tail of the squirrel. The produce of the trees varies considerably; in some districts a pound of the semilla, sown in October, will yield a harvest of twelve pounds in January, and leave sufficient of the eggs to continue the produce till May, in which time they sometimes collect thirty-six pounds more. In other districts, where they are occasionally exposed to slight frosts, though great care is taken to cover the plants at night, they scarcely gather more than twelve pounds for each pound that has been sown. At the time of harvest, the insects are killed, sometimes by throwing them into boiling water, sometimes by placing them in heaps exposed to the burning sun, and sometimes in a kind of vapour bath. This last method is deemed the best,

as it preserves the whitish powder on the body of the insect, which gives it an increased value in the estimation of the merchants at Vera Cruz and Cadiz. There are rigid laws to prevent the adulteration of this valuable commodity, but they are found to be insufficient wholly to stop the practice. It is, however, generally believed, that the mixture of other substances, where it is grown, is trifling in comparison with the additions made to it at Vera Cruz, and in the ports of Spain. The whole quantity exported from Mexico, *communibus annis*, was about 2,500,000 pounds, which, before the heavy duties imposed on it, both in Mexico and Spain, was not estimated at more than L.600,000. The quantity produced has greatly diminished of late years. The Indians have discovered, that other commodities pay them better for the labour of cultivating, and hence, in the last ten years, the produce is lessened nearly one half. The dyers of Europe have, however, found a substitute, so that, with the reduced supply, there has been no sensible increase in the price. Lac lake, a commodity from India, has in a great measure superseded it, both in England and France, and will probably, at no distant period, do so in other countries.

Bees-wax is an article of considerable importance in a country where the pomp of religious worship requires a great supply of wax-tapers. In the churches of the cities, and even of the Indian villages, the consumption is enormous. The indigenous bee of New Spain differs from that of Europe in having no sting, or at least none of sufficient strength to inflict the slightest wound. They are known by the name *Angelitos,* little angels. Their wax is abundant, but it is more difficult to bleach than that which is produced by the bee of Europe. Some of the Indians have farms of several hundred hives. Mexico does not produce sufficient wax for its own consumption, but obtains the requisite quantity from Cuba, where both the European bee and the American are carefully bred for the sake of the wax.

Besides the productions of agriculture, which have been enumerated, Mexico is abundantly supplied with animal wealth. When first discovered, the inhabitants had few or no domesticated animals. Europe has, however, furnished them with a few, which have become the rudiments of immense herds; they now cover many of the plains, and furnish to their inhabitants an ample supply of animal food. The tallow of their oxen suffices for all the manufactories of soap and candles; oil being too valuable to be used for the former of these purposes. Hides were formerly exported from Mexico to Spain, but, of late, the population and their wealth has so increased, that they are all converted into leather for their own consumption.

Sheep have never been encouraged, though the pastures are admirably adapted for their feed and propagation. The wool, which what few they have produce, is consumed in their manufactories; and as cotton cloths are better suited for the greater part of Mexico than woollen, we may attribute the neglect of sheep to that circumstance. Turkies and ducks were originally sent to Europe from America, which, in return, received the common fowls of the Old Continent; but the common goose of Europe is not yet to be found in any of the Spanish settlements in America.

Having enumerated the most important agricultural productions of Mexico, we must state, that though the principal branch of industry which has contributed to enrich the country, agriculture is still by no means in that state of activity to which it is capable of arriving. The indolence natural to man, when all his positive wants can be supplied with little exertion, must act as an impediment to the progress of agriculture, as well as of all the other arts. The want of roads, canals, and navigable rivers, whilst it continues, is an insuperable bar to great improvements; and, when to these are added the restrictions imposed by an impolitic government, we are rather surprised at the progress Mexico has made, than that she has made no greater. Amidst other impediments to her improvement, the want of capital is a most important one. It is so in every country, and peculiarly so here. The capitals acquired by mining have frequently been afterwards employed to give activity to agriculture, the only purpose to which capital can be beneficially applied in a country where little or no commerce exists. The convents, and other ecclesiastical communities, possess but little landed property. Their real wealth consisting of the accumulations from tithes, and other clerical sources, has been generally dedicated to agricultural improvements. The capital of the clerical bodies, amounting to more than L.10,000,000 Sterling, is lent out, in small sums, on interest, to proprietors of land, and secured by mortgages on their estates. The benefit conferred by such a capital applied to the agriculture,—a capital gradually increasing, must be very considerable. Such was the impression of its importance on the spot, that when, under the ministry of Godoy, orders were transmitted to Mexico to send these funds to Europe, it caused general murmurs; and though the viceroy had not sufficient firmness to defer, or to demonstrate the impolicy of executing the decree, but attempted to enforce it, the difficulty was so great, that in two years only the small sum of L.250,000 could be collected. One legal evil is felt in Mexico, as it is in Spain. The greater portion of the land, especially the larger tracts of it, is granted in what is called *Mayorazgos,* a species of entail which prevents alienation, or the division of land into smaller allotments, such as would be suitable for the purchase and the improvement of the class of small capitalists.

Minerals and Produce of the Mines.

There is something very striking in the reports which circulate in Europe of the wealth of Mexico and Peru; but perhaps the mineral wealth, which those countries furnish, has produced less effect on them than on the nations of the Old Continent, whose activity and intelligence has been forcibly stimulated by it. The mineral riches of Peru have been to no extent applied to sustain agricultural industry, which has languished in consequence. If Peru has not declined within the last century, she has certainly not advanced much in population or industry, in productions or in civilization. In Mexico, where the riches from the mines have stimulated agriculture, the progress has been considerable, more especially within the last forty years, in every thing that

can conduce to the greatness or the prosperity of a country.

The whole quantity of gold produced in Mexico, on an average of several years, does not amount to more than 7000 marks, or 56,000 ounces, and is worth about L.200,000 Sterling. This quantity is collected, either by washing the sands in the torrents which descend from the mountains, from some mines of small produce in the intendancy of Oaxaca, or from the silver mines, in which it is found combined with that metal. The silver which the mines of Mexico distribute over the globe is by far the most important part of what has recently been put in circulation. In a series of years at the beginning of the present century, according to the books of revenue by which the tax called the *fifth* is paid, the mean produce has been 22,170,000 piastres; and, estimating that portion on which the duty was evaded at somewhat less than a seventh part, we may consider the total at least as 25,000,000; worth, at the average rate of silver in Europe, L.5,480,000 Sterling. This quantity exceeds the whole silver that is produced from all the other parts of America, whether belonging to Spain or Portugal.

The whole of the silver mines of Mexico are in the table-land, and most of them are at a great depth from the surface. They have been calculated to amount to nearly three thousand, and are divided into 450 districts, each governed by a council of the mines. It will be easily supposed, that, of these 3000 mines, some must be very inconsiderable, and some very unproductive, when it is ascertained that half of the silver raised in New Spain is the product of only three districts, viz. Guanaxuato, Catorce, and Zaccatecas. In fact, it appears that the whole of the mines do not pay an adequate profit for the capital that is employed in excavating and working them. On some of these undertakings the whole sum that is embarked is totally lost, and the works are abandoned. On others the product is for a long time much less than the expenditure; but they are continued with the hope that the proprietors will be so lucky as to meet with a rich vein of ore, that will repay them by immense wealth for the expence, trouble, and anxiety they have endured. Some of the mines, however, prove so enormously lucrative, that, like any other gambling, the adventurers are encouraged to continue the game as long as their money or their credit remains.

Working of the Mines.

It is of great importance to the mines of Mexico, that, unlike those of South America, they are found in regions of moderate elevation and temperature. The greater portion of the most valuable are at the height of from 6000 to 10,000 feet above the level of the ocean, and, consequently, exempt from that severity of cold which is found so injurious in Peru. In consequence of the country round the mines being thus in healthy and fruitful elevations, the great number of labourers which they require easily find subsistence; and whenever an extensive mine flourishes, the concourse of people which it collects creates a market for food, to supply which, the uncultivated fields around them are brought to afford the requisite supplies; and towns spring up, and land becomes fruitful, where a few years before only uncultivated deserts were to be seen. It is from the healthiness of the climate in which the mines are situated, and from the fertility of the land around them, that Mexico has been enabled to extract so great a quantity of mineral wealth, rather than to the richness of the ore, or to the accessibility of the veins. The mines of silver at Obergeberge, in Saxony, which are by no means excessively beneficial to the proprietors, will show how much the value of the mines of Mexico depend on the cheapness of labour, arising from the ease with which subsistence is obtained in a fruitful country. In each quintal of the Saxon ore that is extracted, they have commonly found ten ounces of silver, and in fortunate periods it has averaged fifteen ounces. The mean produce of the mine of Guanaxuato is four ounces in each quintal of ore. In other mines, the produce is from two to three ounces *per* quintal, and in few does it exceed five. The average is calculated by Humboldt at between three and four ounces. The mines of Mexico are much deeper than those of Saxony. Valenciana has a shaft of 1680 feet from whence to bring up the ore, whereas the richest of the Saxon mines, Himmelsfürst, is only 1100 feet in depth. The fruitfulness of the country around the mines is not the sole cause of their superiority, for though, as we have seen, the ore is by no means rich, yet the breadth of the veins in which it is found is highly favourable to the facility of raising it. A mine in Saxony, where the vein is six feet in extent, is considered as a prodigy, but the (*veta madre*), mother vein of Guanaxuato, is from 130 to 145 feet in extent. The Saxon mine has been worked in length about 700 yards, whilst the broader one in Mexico has proceeded already to double that distance. The extent and length of other veins are of the same extraordinary dimensions, and the smaller veins, which in Europe would be worked, are left in total neglect. The use of machinery to diminish animal labour is but feebly adopted, and the execution of those few machines they construct is so bad, that they are scarcely of any benefit. As the ore is brought from the mine on the backs of men, it is necessary that the descent should be made very capacious. That of the mine Valenciana is 1680 feet in perpendicular depth, and 90 feet in circumference. This pit is dug in the solid rock, it is beautifully walled, and, when completed, having cost a million dollars, may be considered one of the greatest and boldest undertakings in the history even of Mexican mining. This mine has the peculiar property of being free from water, a circumstance of vast importance, since other mines, equally rich, have been abandoned, because the proprietors have not been enabled to exclude the water, where the steam engine is not yet adopted. In the year 1760, the country around this mine was a perfect desert. M. Obregon, a Spaniard, with a vehement passion for mining, with a small capital, but with the confidence of richer men who assisted him, began to excavate. In 1766, though he had got to the depth of 260 feet, the value of the produce was less than the current expences. He then entered into partnership with a small trader, named Otero, who had some ready money. They continued to pursue

 their operations, with confidence in the result, till, in 1771, they came to masses of sulphuretted silver, mixed with native and red silver. From 1771 to 1804, the mine has constantly yielded a gross produce of L.583,000 Sterling; and in some of the most profitable years, the two proprietors have each shared the enormous sum of L.250,000. The spot where these operations commenced was occupied by a few wild goats, and in ten years it became a considerable town, with seven or eight thousand inhabitants, surrounded with cultivated and highly productive fields. As the miners have gone deeper for the ore, the expences of raising it have been increased; but the quality has so improved, that the net profit to the proprietors has continued the same. The expence of working this mine amounts annually to L.190,000 Sterling; three-fourths of which are for wages to the labourers, and the remainder for gunpowder, steel, iron, wood, leather, and tools of various kinds. The cost of powder for blasting the rocks amounts to L.16,000 annually. The number of individuals employed is about 3000 The principal manager receives a salary of L.2500, and has under him several overseers, and nine master miners. These head men visit daily the subterraneous operations, on the backs of men, who have a kind of saddle for the purpose, and are called little horses (cavalitos).

The whole of the labour of the mines is performed by freemen; no slaves or convicts are employed; and the stories circulated in Europe of criminals and smugglers being condemned to labour in the mines are totally without foundation. The labour, though voluntary, is very severe, and the people are stimulated to perform it only by being paid, not by the time occupied, but by the quantity of work that is performed. The ore is carried solely by men, who are so accustomed to this kind of labour, that they remain with a load from 240 to 370 pounds on their backs six hours at a time, during which they ascend many thousand steps in the pits, in a temperature from 71° to 77° of Fahrenheit. They proceed in files of fifty or sixty, among whom are some boys of ten or twelve years old, and some men more than sixty, each of them loaded according to his own estimation of his strength. In ascending the stairs they throw the body forward, and support themselves with a staff about a foot long. They walk in a zig-zag direction, having found by experience that their respiration is thereby less impeded. The muscular strength acquired by these men must be prodigious, since, without any burden, a person not accustomed to it, feels intolerably fatigued from ascending and descending so many thousand steps. The weight of each load is agreed on before the ascent is begun; regular registers of the quantity carried by each individual is entered by accountants; and the quantity of ore brought from the mine is easily ascertained to the satisfaction of all parties. Each digger of the ore is calculated to loosen as much from the vein as three of the porters can carry away. This operation is performed with a kind of iron crow, with a sharpened steel point, that requires perpetual repointing; for which purpose small moveable forges are placed in various parts of the mines. Though the workmen are almost naked, and are closely watched and carefully searched, they sometimes contrive to embezzle considerable portions of the richest minerals, by concealing them in their hair, under their arms, and other parts of the body. These thefts are often detected, and a register is kept of what is thus seized from the depredators. In the mine of Valenciana it amounted, in fourteen years, to the value of L. 36,000 Sterling.

Though the mine of Valenciana has produced the most uniform profit to its owners, that of Sombrete, in the intendancy of Zaccatecas, has produced the largest profit in a short period. A portion of this mine, called (*veta negra*), the black vein, yielded to its proprietors, the family of the Marquis del Apartado, upwards of L. 800,000 Sterling within six months; and though nothing approaching to that profit has since been gained, it still holds its rank among the mines of the first class. The mines of Catorce have been begun but recently to be excavated. This district was first explored by an accurate and adventurous miner, in 1778. He was fortunate enough, at the first trial, to hit on what is called the great vein (*veta grande*), and in a very short time gained more than half a million dollars by it. The great riches of the vein, however, were not developed till it had been carried 350 feet down, whence, to the depth of 550 feet, they found the metals called *colorades*, a mixture of silver and gold, and abundance of native silver. At that period the expence of working scarcely exceeded 80,000 dollars, whilst the value of the metals amounted to 1,200,000. This vein is of the extraordinary breadth of 130 feet. It continued highly productive till 1798, when it had reached a depth of 1574 feet; since that time the mineral has become less valuable, the *metales colorades* have disappeared, and pyritous and coppery minerals are found with the silver. It is, however, still worked to considerable profit, but not to the extraordinary advantage which was yielded between 1778 and 1798.

When the ore is brought to the surface, there are two modes of separating the minerals from the substances in which they are incorporated; smelting and amalgamation. The first of these processes is so familiar, as to need no description, being nearly the same as is applied to all other minerals. It is used in Mexico in not more than one-third of the mines; and if the uncertainty of obtaining sufficient mercury was removed, and the price of that commodity properly reduced, it would be practised in still fewer, especially as the wood required for firing is becoming scarce on the ridge of the Cordilleras, the most populous of the mining countries. As the scarcity of wood increases, the abolition of the process of smelting will become an object of considerable importance to the various manufactories that are carried on in that district. The progress of amalgamation depends on the quantity of mercury that can be conveyed to the mines, and as a naval war intercepts the supply, that process is necessarily greater in time of peace. In the process of amalgamation, the first step is to reduce the ore to a fine powder, which is done by well constructed mills. As the adhesion of the particles to the quicksilver depends on their fineness, this opera-

tion is more attended to than any other. The powdered ore is moistened, and in that state, called *schlich*, is carried to the court of amalgamation, an open space paved with hard flag stones. The floor is covered with the schlich, and levelled so as to form a heap from 60 to 90 feet in length, and about two feet in thickness. The materials for amalgamation are then added to it, and consist of muriate of soda or common salt, sulphate of iron and copper, lime and vegetable ashes. The salt is first applied, the quantity of which varies with its purity, which is very various, sometimes amounting to twenty, and sometimes to not more than four pounds, for every quintal of the mineral paste. The mineral, thus mixed with the salt, is left for several days till the whole of the latter is supposed to be dissolved and equally distributed. If the metal is then deemed too warm, or in a state of oxidation, and charged either with sulphates of iron and copper, which rapidly decompose in the air with muriate of silver, lime is added to cool the mass. But if the paste is thought too cold, as it will be, if it contains sulphate of lead or pyrites, which decompose with difficulty in humid air, sulphate of iron and copper are added, which are known to heat the composition. This is thought necessary, and it is only considered to be well prepared when a sensation of heat is felt by holding it in the hand. After leaving the mixture some days to repose, the mercury is begun to be incorporated with it. The quantity of mercury is fixed by the estimation made of the quantity of silver which the composition will yield, and they usually add to the mixture about six times the weight of quicksilver, which they expect will be produced in pure silver. Shortly after the addition of the mercury, sulphate of iron and copper are administered to it again, if too cold, or lime, if too hot. During the space of three, four, or even five months, its temperature is watched, and corrected by the application of the lime, or the sulphates, as either one or the other may be required to make the mercury act on the silver. During the whole of this part of the operation, the action is favoured, and the union increased, by stirring the materials. This is usually done, by causing twenty or thirty horses, or mules, to run round for several hours, or by setting workmen to tread the mass, who go for whole days barefooted in this metallic mud. When it is known by the appearance of the mass, of which those accustomed to the process are accurate judges, that the mercury has united with all the particles of the silver contained in the mixture, the metallic muds are thrown into large vats of wood or stone. Small mills, provided with sails, placed perpendicularly, turn round in those vats. A stream passes through them, by which the earthy and oxidated parts are carried away, whilst the mercury and the amalgam remain in the bottom of the vat. The amalgam remaining at the bottom of the vat is then, in some measure, discharged of the mercury, by pressing it through sacks. The amalgam is then moulded into a pyramidical form, and, in that state, goes through the process of distillation, by which the remainder of the mercury is evaporated, afterwards condensed, and preserved for future use. In this process, however, a loss of mercury is suffered, generally from an ounce and a half to an ounce and three quarters for each ounce of silver that is produced. Our business here is to describe the process, not to point out its errors, or to show that the same effect might be produced in a less expensive, and far more expeditious manner. Among so many thousand mines, the owners of which are the most independent of mankind, there are to be found many deviations from this mode of amalgamation, but we have described that mostly followed, without examining, with chemical criticism, the effect which would be produced if the mass of *schlich* was placed in a court paved with iron and copper instead of stone, or if the process of stirring would be more beneficially performed with ploughs of iron or copper, than by the feet of horses, mules, or men. This has been urged in Mexico, and will probably be adopted as soon as the benefit of it is clearly understood. The method of amalgamation has been the cause of the increase of the Mexican mines. By it, all the silver in the ore may be extracted from it, and now the residuum, which, under the former process, used to be thrown away as of no value, is made to produce a quantity of silver, that amply repays the expence of collecting it.

Since this mode has been adopted, the consideration of the quantity of mercury that can be procured becomes of vast importance. The present consumption of Mexico requires a supply of 16,000 quintals, which, in time of peace, is supplied from Europe. The mine of Almaden, in Spain, would have furnished this quantity, but for an inundation, which, for want of timely attention, destroyed the works. The mine of Huancavelica, from similar carelessness, had ceased to be worked, or produced but little. In these circumstances, the court of Madrid made a contract with the Austrian government, for a supply to be furnished from the mines of Istria. The mercury from Germany either was, or was supposed to be, less pure than that of Almaden. The government of Spain have unwisely made quicksilver the subject of a royal monopoly, and an article of revenue. The price is thus raised, and the supply uncertain. Intrigues are carried on by the miners at the viceroyal court of Mexico, either to obtain a large quantity, or a greater proportion of Spanish than German quicksilver; and these smaller proprietors, who either have no access to the court, or have no means of creating an influence there, are compelled to be satisfied with a small portion, and that portion what is deemed of the inferior quality. The power of the viceroy to distribute quicksilver whenever it has been scarce, has been the means of great oppression on many miners, and a source of wealth, scandalously enormous, to the viceroys. The price at which the court of Madrid supplies its provinces with quicksilver is of vast importance, both to their and her own prosperity; whereas the revenue drawn from the monopoly is impolitic in its principle, corrupt in its practice, and small in its amount. The court has, indeed, gradually reduced the monopoly price from 82 to 41 dollars the quintal, a price, perhaps, as low as the consumers could obtain it on an average of years, if a competition was permitted. The great evil now arises from the favouritism by which the interests of the

 small proprietors are sacrificed to those of the greater. It is also no inconsiderable evil, that a supply proceeding from only one source, and that not the most unexceptionable, must be very uncertain, and often very scanty. In New Spain, the indications of mercury are very visible. Cinnabar is found in many parts, and sulphureted mercury in others; but these mines have engaged little attention, and the monopoly of the government has acted as a bar to their being effectually investigated.

Although the mines of Mexico are all of them the property of individuals, or of voluntary partnerships, yet they have a bond of union in a tribunal or corporation, which makes laws to regulate the rights created by the mining system, and (though they can only recommend) to institute improvements in the various processes. When, at the early period of the occupation of Mexico, the Spaniards first began their mining operations, a mixture of laws, some Spanish, some German, and some Flemish, emanated from the court of the Emperor Charles the Fifth. Their contradictory nature induced the proprietors of mines to form a board, which at first was a voluntary union, but has since been recognized as a legal corporation, endowed with considerable revenues, and invested with extensive authority. The board called *Tribunal General de la Mineria de Nueva Espana* is composed of a director, two deputies from the provincial councils of miners, an assessor, two consultors, and a judge. They are chosen by the thirty-seven provincial councils of the miners, and have two deputies constantly residing at Madrid to protect their interests at the seat of government. They direct the studies in the College of the Mines, and select from thence students, who are sent for the purpose of communicating instruction to the chief towns in the mining districts. The influence of these students is, however, confined; they have no power to direct the most beneficial processes; and the jealousy of the miners regarding their liberty prevents the full benefit which might be derived from this diffusion of men of scientific acquirements. The institution of the tribunal, especially under the organization it has received within the last forty years, has been of great benefit to the proprietors of mines. It has preserved a degree of public spirit, disseminated the knowledge of new facts and improvements, and created a community of feeling among all those connected with the important affairs of the mines. This board is endowed with an annual income of more than L.40,000 Sterling, arising from the signorage which is divided between it and the crown, on all the gold and silver coined at the royal mints. The revenue was designed to support the School of Mines, and to be lent out to feebler proprietors, to assist their operations. It has been useful, to some extent, in both ways; but the court of Madrid, in the state of poverty which has compelled it to lay its grasp on money wherever it could be found, has extorted, under pretence of a gratuity and a loan, near L.700,000, which has absorbed more than its accumulation, and now one-half of its revenue is destined to pay the interest of money which has been borrowed to lend to the government.

The taxes levied on the mines are weighty, and produce a revenue, which, though much evaded, is still very large. Formerly the king received a fifth of the produce of all mines, and though this tax has been reduced to half that proportion, it still retains its ancient name *el quinto*. The quinto is now 10 *per cent.*; another duty called the 1 *per cent.* is added; besides which, for coinage and seniorage, including the share of the tribunal of mines, 2½ *per cent.* is paid; making together a charge on the proprietors of 13½ *per cent.* on the amount of the gold or silver that is extracted. Considerable intricacy exists on this subject. When the minerals contain, as they frequently do, a mixture of gold and silver, this gives rise to endless discussions, and opens a field for oppression, for bribery, for chicane and corruption, which ultimately tends to enrich the larger proprietors in some degree, and the officers of the revenue in a much greater.

Besides the more precious metals, gold and silver, which we have thus far exclusively viewed, Mexico abounds in the other mineral riches, which equally contribute to the improvement and enjoyments of man in the social state. Iron is found in great abundance in the intendancies of Valladolid, Zaccatecas, and Guadalaxara, and especially in the more northern provinces. The increased production of these mines is always suspended by a return of peace, however much they may have yielded in the preceding periods of war. The difference in price in war and peace, both in iron and steel, is enormous. The former has sometimes risen from 20 to 240 the quintal, and the latter, which commonly in peace was sold for L.3, has been known in war to be worth L.50. During the early part of the wars occasioned by the French Revolution, the tribunal of mines advanced money to the iron miners, but the works were suspended by the peace of Amiens. When war recommenced, these mines were resumed, but very imperfectly, and the tribunal having lent its capital to the government, could offer them no assistance.

Copper is found in a native state in the intendancy of Valladolid, and some in Guanaxuato. Tin is found in mines, but is principally extracted from the earth washed down in the deep ravines. A combination of these two metals, both of which were known to the ancient Mexicans, though they had not discovered iron, was used to form their tools and weapons. By an examination of one of their implements by some French chemists, it was ascertained that they had the art of tempering these two metals, so as to render them equal in effective utility to iron, or even steel. Lead is found, but the mines are very little worked. Zinc is found under the form of a brown and black *blende* in several veins. Antimony is produced in Catorce; arsenic, combined with sulphur, has been extracted from the minerals found in Zimapan. Neither cobalt nor manganese has yet been discovered in Mexico; and both these minerals, though the latter has been discovered in Cuba, appear to be less abundant in the equinoctial regions of America than in the temperate climates of the ancient continent. To complete our view of the minerals of New Spain, it is necessary to state, that coal mines have been discovered in several parts of the

Mexico.

northern provinces, and one is slightly worked near the sources of Rio Sabina. Rock salt is also found in many parts; and, if necessary, more might be obtained. It is principally required for the process of amalgamation in the silver mines, as the Indians scarcely use it with their food, but adhere to their ancient practice of applying the Chili as the sole condiment to their food.

Revenues

New Spain, unlike the colonies of the other European nations, not only produces a revenue adequate to the expence of its own government, but a surplus to assist the mother country. Owing to the very impolitic arrangements of the government, the expences of its collection amount to more than one-fourth of the gross sum of the revenue. The taxes levied on the mines are the most productive; these have been before described, and amount, on an average of years, to . 3,516,000 dollars.

Net profit of the mints,	1,500,000
Profit on the sale of mercury,	536,000
	5,552,000

The monopoly of tobacco, after deducting the expence of the cost of the leaf tobacco, is 594,000 dollars; and that of manufacturing it into snuff and segars, which is 1,285,000 dollars, produces 4,500,000 dollars; but this particular branch of revenue is reserved to the crown, and not mixed with the general produce of the taxes, but remitted to Spain in a distinct head of account. The alcavala, or duty on sales, from which the Indians are exempted, produces net about 3,000,000. The Indian capitation tax yields 1,300,000. The duty on the fermented liquor made from the Agava, called Pulque, produces 800,000. The Almoharifazgo, or duties on foreign trade, is 500,000. There are some other articles, which we shall presently enumerate; but in the mean time we must mention, that the king has a monopoly of *fighting cocks*, and of *snow* from the mountains, which, whimsical as it may appear, are both thereby subjected to taxation, and this tax, though trifling, is found very irritating to those who love a barbarous amusement, and to those who wish to enjoy cool liquors under a burning sun.

Net Revenue of New Spain.

Tax on minerals, profit on coining and mercury, . . .	5,552,000
Monopoly of tobacco, . .	4,500,000
Alcavala, ...	3,000,000
Indian tribute, or capitation tax,	1,300,000
Duty on pulque, ...	800,000
Almoharifazgo, or tax on foreign commerce,	500,000
Monopoly of cock fighting, .	45,000
Ditto of snow, ...	60,000
Profit on Papal indulgencies, .	270,000
Post-office, . . .	250,000
Monopoly of gunpowder, .	150,000
Clerical first fruits, . .	100,000
Profit on playing cards and stamped paper,	200,000
Dollars,	16,727,000

Mexico

By some accounts, it appears, that, when the gross revenue of New Spain amounted to 20,000,000, the expences of collecting it were more than 6,000,000, and, consequently, the net sum paid into the treasury was less than 14,000,000. It should, however, be remarked, that, in the expences of collecting are included the salaries of the viceroy, of the intendants of the provinces, of the different secretaries and clerks, and the pensions of governors retired from office, and all the expences, except those of the military kind, and those of the courts of justice. The revenue of 16,727,000 dollars first pays the military, naval, and judiciary charges; the repairs of fortifications, arsenals, hospitals, and other royal works, 5,700,000 dollars. The other settlements in America, whose revenues fall short of their expenditure, draw from the treasury of Mexico the requisite sums. Florida, Porto Rico, Cuba, Manilla, and St Domingo, draw from New Spain about 3,500,000 dollars annually; and the remainder, about 7,000,000½ dollars, or L. 1,700,000 Sterling, is remitted to the court of Madrid.

From the gross amount of the revenue is, however, to be deducted the salary of the Viceroy. This is the annual sum of 60,000 dollars, which, large as it appears, is of itself inadequate to the state he is compelled to assume, and the expences he consequently incurs. He cannot move without his guards on horseback, most splendidly accoutred; he is constantly served by pages of honour; is forbidden by etiquette from permitting any but his own family to sit at table with him; and preserves constantly more of the state of a monarch than is retained by most of the sovereigns of Europe. He has few honourable and fair means of accumulating a fortune, and hence the few who have filled the office with a desire to benefit the community have retired from the dignity with their original mediocrity. On the other hand, their extensive power has been used by many to enrich themselves, and that to a degree that might satisfy cupidity itself. Some individuals have returned to Spain, after filling the office of Viceroy for a few years, with fortunes of from L. 300,000 to half a million Sterling. The distribution of mercury, the patronage of lucrative places, the dispensing rank in the militia, the recommendation of individuals to the titles of count or marquis, the opening the ports to favour the commercial speculations of individuals, and the winking at contraband transactions; all these ways may be, and often have been, used by Viceroys to the injury of the public, and the pecuniary advantage of their own families. In order to escape inquiry at home, it is necessary that he should have a most intrepid assessor with him, and a powerful party in the court of Madrid; and, with these assistants, there is no knowing the bounds to which his corruptions may be extended.

None of the officers of government have any effectual control over the Viceroy. The court of royal audience, a kind of privy council, and the supreme court of justice, may indeed protest against his acts, and transmit their protests to the Council of the Indies in Spain, but it must obey his orders,

Mexico. without creating delay, how much soever it may condemn them.

Armed Force. An army is constantly kept up in Mexico of about 10,000 regular troops, who are recruited, disciplined, and regimented, within the viceroyalty. Of these about 6000 are in Mexico proper, and the remainder on the various stations on the northern frontier, or in the *provincias internas*. Of the former 1000 are cavalry, 150 artillery, and the remainder infantry. The regular troops on the frontier provinces are mostly light troops, with some flying artillery. Besides these regulars, called *tropas veteranas*, a body of militia (*milicias provinciales*) of 22,200 men is constantly maintained; of these 11,000 are infantry, and the same number of cavalry. The Indians on the banks of the Rio del Norte carry on a constant war with the Spaniards. The troops on that frontier are, in consequence, in a state of perpetual activity. They are all natives of the country. They are tall and robust mountaineers, admirably mounted, and equally accustomed to the extremes of heat and cold. They are constantly under arms, generally on horseback, and perform long marches through deserts with no other provision than a little ground maize, which they mix at any brook with water, and thus subsist without difficulty. It is reported by those who have seen these troops, that it would be difficult to find in Europe any cavalry of greater activity in its movements, of greater impetuosity in battle, or capable of enduring greater privations. As these would be the first troops to be encountered, in case hostilities between the United States and Spain should lead to an invasion of New Spain by the former, they are entitled to this brief notice. Almost the whole frontier towards the United States is by nature nearly impenetrable. Arid savannas, resembling the deserts of Tartary, separate the provinces of Mexico from the United States. Beyond the 32d degree of north latitude the extent of the deserts and the nature of the soil afford security against an invading enemy. To the southward, between the Mississippi and Rio del Norte, several rivers intervene. The ground towards the shore is swampy, and these swamps filled with impenetrable thickets. On this point the two countries at present approach nearest to each other; the American post Fort Clayborn is distant from the Spanish presidio of Nacodoches only about sixty leagues.

Ecclesiastical Establishments. Although the religious establishment in Spain is most profusely endowed, that example has not been followed in Mexico to so considerable an extent. The numbers of the clergy bear a proportion nearer to the Protestant than to the Catholic countries of Europe. The Archbishop of Mexico is the metropolitan, and has under him eight bishops, the differences in whose revenues are very striking.

Bishops and their Revenues.

	Dollars.
Archbishop of Mexico,	130,000
Bishop of La Puebla,	110,000
——— Valladolid,	100,000
——— Guadalaxara,	90,000
——— Durango,	35,000
Bishop of Monterey,	80,000
——— Yucatan,	20,000
——— Oaxaca,	18,000
——— Sonora,	6,000

The inequality of income seen in the bishopricks extends also to the curas or parochial clergy, some of whom have incomes amounting to 15,000 dollars, whilst others have scarcely 100. The religious houses are in many instances rich, but not from their possessions in land, so much as from their accumulations which have been improved by lending on mortgages to the proprietors of lands at high interest. The revenues of the church being derived almost solely from land, in the form of tithes, have partaken of that advance which the increase of cultivation has produced. The difference in the value of tithes taken at two following periods, will show both the increase in cultivation, and in the revenues of the church. Produce of tithes from 1771 to 1780, 13,357,157 dollars,—from 1781 to 1790, 18,353,821 dollars.

The proportion between the regular and secular clergy is not ascertained, but the whole of the religious of both orders, including nuns, monks, lay-brothers, probationers, choristers, and servants, do not exceed 14,000 persons.

The political division of New Spain is into twelve intendancies, to which may be added three provinces which, though under its government, are removed to a considerable distance, and are rather dependant upon it, because no other plan of ruling them has yet been adopted, than from any design that they should ultimately be considered a part of it. The intendancies are, Intendance and Provinces.

Mexico	Oaxaca
Puebla	Merida
Guanaxuato	Vera Cruz
Valladolid	San Luis Potosi
Guadalaxara	Durango
Zaccatecas	Sonora.

After a sketch of these, the provinces of New Mexico, Old California, and New California, will be noticed.

The intendancy of Mexico merits the first consideration, on account of its being the most populous, the most rich, and as containing the capital of the kingdom, and the seat of the government. Its extent is 5927 square leagues, and its inhabitants, by the census of 1803, amounted to 1,511,800. It extends from 16° 34′ to 21° 57′ of north laditude. On its western side a portion of the province is washed by the South Sea from Acapulco to Zacatula, a distance of 270 miles, but no part of it approaches nearer than 35 miles to the Eastern Ocean. The intendancy being both on the high and the low land, must partake of the climate of each, but more than two-thirds of it is mountainous, and consequently cool and healthy; whilst that part which borders on the South Sea, has all the heat and insalubrity usually encountered in similar circumstances. Only the highest peak of one of its mountains enters the region of perpetual snow; and no other summit but Intendancy of Mexico.

Mexico. this of Toluca is equal in height to Mont Blanc in Switzerland. The best and most valuable portion of the intendancy is the Valley of Mexico, which is called a valley, because surrounded by ridges of higher hills, but is yet 7500 feet above the level of the ocean. The drains of the hills around the plain run towards the city, in the vicinity of which they form the lakes of Tezcuco, Zumpango, San Christoval, Xochimilco, and Chalco. Tezcuco, from the muriate and carbonate of soda in the soil, is brackish; the other lakes are of good tasted water, and all are abundantly stocked with fish. These lakes have gradually been drying up, ever since the country has been occupied by the Spaniards. The great quantity of trees which have been cut down for building, whilst none have been planted, has exposed both the soil and the lakes to a greater degree of evaporation, as well by a greater surface on which the direct rays of the sun operate, as by laying them open to the influence of the drying winds from the south. Artificial means have been also applied to a most expensive, if not an effectual extent, for draining the Lake of Tezcuco, and preventing it from inundating the capital, as it has sometimes done in a most injurious degree. Operations have been carrying on for near 300 years to prevent these inundations, by turning the Lake of Zumpango into a stream, that shall empty itself by the River Tula to the Gulf of Mexico. The labour, and even the lives, of numberless Indians have been lavished on this undertaking, and the expenditure has already amounted to L.2,000,000 Sterling. It is a canal of most stupendous dimensions; but from the friable nature of the soil through which it is conducted, from frequent variations in the design, and numerous errors in the execution, it does not yet operate as an effectual security, or insure the inhabitants from these fatal inundations, by which at several periods they have been visited. The lakes in the immediate vicinity of the capital are made to supply considerable quantities of vegetables and fruits, by means of floating gardens; an invention of more importance, when the city was almost covered, and wholly surrounded with water, than at present; but which has, however, been continued by the Indian families to the present time, and furnishes the means of subsistence to many of them. These gardens (*chinampos*) are formed of reeds, rushes, roots, and branches of brush-wood, which are converted into a raft; on these materials is laid the black mould, which is strongly impregnated with muriate of soda. The soil is gradually purified from the salt, by frequently washing it with the water of the lake. Even the water of Tezcuco, which, though salt, is not highly saturated, has the effect of dissolving the salt in the soil, and by each washing the fertility is increased. Some of these gardens contain the cottage of the proprietor, on which he guards a group of surrounding chinampos. They are towed or pushed by long poles from one part of the lake to the other, and in process of time, as the lakes have subsided near the banks, these gardens have become fixed, and at length, by farther fall of the water, have become dry ground. Each chinampa is about 330 feet long, and 20 broad. The mould, purified by frequent irrigations, is heaped to the height of three or four feet above the surface of the water. Beans, peas, capsicums, potatoes, artichokes, cauliflowers, and other vegetables, are cultivated upon them; the borders are generally ornamented with flowers, and sometimes a hedge of rose bushes is planted as a fence around them. One of the most agreeable recreations of the inhabitants of the city is taking the air in boats among these delicious floating gardens.

City of Mexico. The city of Mexico, the most extensive, populous, and wealthy of any place in the western hemisphere, is built on what was formerly a lake, and is still a marshy soil, between the two lakes of Tezcuco and Xochimilco. The centre of the city is distant from the former two miles and six furlongs, and from the latter five miles and a half. It equals in regularity of buildings, in equality of surface, and in the breadth of its streets, St Petersburg, Berlin, or the best parts of Westminster. The houses are built of stone, with flat roofs, and generally display considerable architectural taste. The public buildings are magnificent, and have been constructed at enormous expence. The most considerable of these is the Viceregal Palace, an extensive but heavy edifice; the Cathedral, a magnificent building, whose execution occupied ninety years, and which is most profusely adorned with gold and silver images, rails and lamps of solid silver, and other decorations of the same expensive character. There are near one hundred other churches, which are for the most part ornamented and decorated with the same lavish profusion. The Royal Mint is a splendid building, and one hundred workmen are constantly employed in it. The edifice destined for the School of Mines cost in building L.125,000, and would be thought an ornament to the best parts of Paris or London. The Plaza Major is adorned with a beautiful equestrian statue of King Charles the Fourth, cast in bronze in this city by a native artist. It is considered a *chef d'oeuvre* of art, and its weight, which is twenty-two tons, must have employed mechanical talents of no common order to place it on the pedestal which supports it. The Treasury near the Viceroy's palace is more remarkable for having been the spot from whence have issued more than one thousand five hundred millions of dollars, than for any peculiar beauty or taste in the edifice. There are many Convents in the city, the principal one, that of the Franciscans, is of great extent, and possesses a large revenue. There are several Nunneries, the principal part of whose inhabitants are the females of the higher Indian families, and some few of the white Creoles.

State of Science and Learning. Education is not totally neglected, though it is rather at a low ebb. The University is a richly endowed establishment, and has abundance of professors, canons, and the other offices which might be usefully employed. The mathematics, chemistry, and botany, are more studied than the classics, but scholastic divinity is the most favourite pursuit, in an institution whose principal design it is to qualify youth for the clerical profession. The study of mineralogy is prosecuted with ardour in the school for that science. A botanical garden is established, very richly furnished with the rarest specimens of those plants which are interesting either to commerce or medicine. An Aca-

Mexico. demy for the Fine Arts, furnished with a good collection of ancient casts, has been useful in fostering a correct taste, which has been displayed in the equestrian statue already noticed, and in a beautiful sepulchral monument consecrated to Cortez by his descendant the Duke of Monteleon, which was constructed by Tolsa, and stands in the chapel of the hospital *de los naturales*. Instruction in the fine arts is communicated *gratis*, and for this purpose an annual revenue of more than L.5000 is appropriated. The building assigned to it contains a much finer assemblage of casts than is to be found in any city of Germany. Casts of the Apollo Belvedere, Laocoon, and other large statues, have been transported over the worst roads, and over higher mountains than St Gothard or St Bernard. The casts were purchased in Europe at an expence of more than L.8000, exclusive of the cost of conveyance. The Academy has laboured successfully to introduce among the artisans a taste for elegant and beautiful forms. Every evening the large rooms of the building, well lighted with Argand's lamps, are filled with hundreds of young people, some of whom are occupied in drawing from relievos or living models, and others in copying drawings of various kinds; and in this assemblage the distinctions of rank depending on complexion seem to be waved, as the whites, the Indians, and the Mestizoes, meet on equal terms, and enjoy equal advantages of instruction.

The knowledge of chemistry is very generally diffused throughout Mexico; it is called the *nueva filosofia*, and the natives even in the distant provinces are accustomed to reason on its principles and results. The best work on mineralogy in the Spanish language, *The Manual of Oryctognosy*, according to the principles of the school of Freyberg, by M. del Rio, was published in Mexico, as well as the first translation of Lavoisier's *Elements of Chemistry*. The School of Mines possesses a chemical laboratory, a geological collection arranged according to the system of Werner, a physical cabinet furnished with the instruments of Ramsden, Adams, Le Noir, and Berthoud, and also models executed with great accuracy by native artisans. The Court of Spain has sedulously promoted botanical researches in each portion of its extensive transatlantic dominions. The botanical garden in Mexico exhibits specimens of these expeditions. One of the commissioners for New Spain, M. Sesse, after returning from the expedition, and arranging his collection, delivered a course of botanical lectures, which are now continued by M. Cervantes, whilst M. Echeveria describes the extraordinary beasts, birds, and fishes, which the country produces. These gentlemen are both of them natives of Mexico.

Mathematical knowledge, though not neglected, is less assiduously cultivated in the University of Mexico than in the School of Mines. The pupils of this last institution proceed farther in analysis, and are instructed in the integral and differential calculus. As the return of peace has supplied them with chronometers, sextants, and repeating circles, we may hope for accurate observations from the most remote provinces of the viceroyalty. The taste for astronomy is of ancient date in Mexico. It had three distinguished cultivators in the last century,—Velasquez, Gama, and Alzate. They made a number of observations, especially on the eclipses of Jupiter's satellites. Alzate was the correspondent of the *Academy of Sciences in Paris*, and though, from directing his attention to too many objects, he sometimes was led into error, he is entitled to great praise for having excited among his countrymen a taste for science, and a love of research, and for having diffused a considerable portion of physical knowledge by the *Gazetta de Literatura*, which, for a long series of years, he edited.

Don Joaquin Velasquez was the most able geometrician that has been produced in New Spain, and all his geodetical and astronomical labours bear the stamp of the greatest accuracy. He was born in July 1732, at an obscure Indian village. His uncle, a parish priest, placed him under an Indian of Xaltocam, who was deeply versed in the Mexican history and mythology, for his education, where he acquired a knowledge of the various languages of the indigenous inhabitants, and perused their hieroglyphical writings. He was removed to the Tridentine College in Mexico, which then had a paucity of books, instruments, and able instructors. With such assistance as he had, however, he commenced the study of the mathematics, and was at length made happy by an accident, which placed in his hands the works of Bacon and Newton. From the one he imbibed a taste for astronomy, and from the other learnt the true method of philosophizing. Being then poor, he began jointly with his friend Guadalaxara, since Professor of Mathematics in the Academy, to construct telescopes, quadrants, and other instruments. Having entered on the profession of the law, the fees he received as an advocate were destined to procure from England those instruments which his love of science made desirable. He continued his studies with much assiduity, and was at length appointed a professor in the University. In 1769, he was appointed to observe, in California, the transit of Venus, and to make other astronomical observations. He rectified the errors in the geographical positions of various places in that country, and availed himself of its translucent and serene atmosphere, to make several celestial observations. The Abbe Chappe, from Paris, had arrived in California during his residence there, to observe the transit of Venus, and was surprised that the Mexican astronomer was found right in having ascertained that the eclipse of the moon on the 18th of June would be visible in California, contrary to his own calculation. He made by himself a very good observation of the transit of Venus over the disk of the sun, 3d June 1769, and communicated the result the same morning to Chappe, and to the two Spanish astronomers, who were his fellow commissioners. In 1772, by a variety of observations, he fixed the latitude and longitude of the capital, and many other important places in the viceroyalty. His labours were indefatigable, and the establishment of the School of Mines, which owes its origin to him, will be a lasting monument of his zeal and ardour in the cause of science. He died in 1786, whilst director-general of the *Tri-*

Mexico.

bunal de Mineria, and invested with the title of *Alcalde del Corte Honorario*.

After these notices, it would be unjust not to mention Gama. Without fortune, and with a numerous family to maintain by severe and almost mechanical labour, he was unknown during his life to his fellow citizens, though they eulogised him after his death. Gama, by his own exertions, became an able and well informed astronomer. He published several memoirs on eclipses of the moon, on the satellites of Jupiter, on the almanack and chronology of the ancient Mexicans, and on the climate of New Spain; all of which discover great precision of ideas, and great accuracy of observation.—It is proper to record these instances of mental proficiency, both as preserving the memory of respectable individuals, and showing that the western hemisphere is capable of producing and developing talent.

Police, Population.

The Acordada, a prison and house of correction, is a very fine and extensive building. It has room for more than 1200 inhabitants, many of whom are destined to reside there, for contravening the revenue laws, and for other offences. Besides the hospital of St Juan de Dios, which, being under the care of the monks, as in the other Spanish dominions, is not considered to receive the best medical treatment; there are several other hospitals, which receive the sick poor, and to which students in medicine are admitted, to acquire the knowledge of their profession. The streets of Mexico are well paved with a most excellent kind of porphyry, and it is well lighted with convex lamps. A common sewer runs through the centre of each street, which is covered with planks, and conveys the filth of the city away. A very good police is maintained, under the direction of the Cabildo, or corporation of the city. Mexico contains a population of about 140,000, of whom nearly one-half are whites, either European or Creole, the remainder Indians, Negroes, and the various mixed casts. There are in the streets, without habitation, and almost without food or work, nearly 30,000 Indians, called Guachinangos, who resemble the Lazaroni of Naples, though, unlike them, they neither beg nor are tumultuous. As a small quantity of labour will enable them to indulge the propensity for drunkenness, they are often seen in the streets in a state of intoxicated insensibility, when they are carried to the guard-house, and, when recovered, set to work by the police. They are employed in cleansing the streets, and, in a day or two, having acquired sufficient to purchase as much pulque as will intoxicate them, they are soon again in the same condition, transferred to the guard-house, and from thence to the streets, and thus pass their lives in alternate drunkenness and punishment.

As Mexico is built on a marshy soil, water is to be found everywhere, by digging a few feet, but this water is not much approved by the inhabitants, except for washing. The principal supply is by means of aqueducts, which convey the water to the different parts of the city. The best is from the lake of Xochimilco, which is remarkably pure and limpid, and runs incessantly. Every kind of provision is cheaply and abundantly supplied from the surrounding districts, which are highly cultivated, and covered with a hardy and numerous population, whose principal occupation is the labour of agriculture. The consumption of pulque within the city is enormous; a duty is collected at the gates which produces annually 600,000 dollars. The consumption of bread in Mexico is, in proportion to the population, nearly the same as in the cities of Europe. Beef is less eaten than mutton; the annual supply of oxen is only 16,000, whilst that of sheep is 273,000. Salt is made near the city. The clayey soil is impregnated with muriate of soda, which is dissolved, and, by evaporation, refined so as to fit it for culinary purposes. In regard to the supply of all necessaries, no city can be more favourably placed than Mexico, and its local position is such as to give it a commanding influence over the whole of the American continent. It can more easily communicate both with Europe and Asia than any other capital, and nothing is wanted to augment its importance to an astonishing extent, but a free commerce, more liberal institutions, and an intercourse with some port to the northward of Vera Cruz, in a more healthy climate than that city enjoys.

Other Cities in this Intendancy.

The next important place to Mexico in the intendancy of that name is Queretaro, a city of 35,000 inhabitants, surrounded with mines, celebrated for its beautiful houses, its aqueducts, and some manufactories of cloth. Tezcuco contains 5000 inhabitants, who are principally employed in the manufacture of cotton goods. Chilpantzingo depends on the cultivation of wheat on the fields that surround it. The number of its inhabitants is about 7000. Cuernavaca, on the southern declivity of the Cordilleras, is in a most delicious climate, and abounds in all the fruits of both climates, being only 3500 feet above the level of the sea. Cuyoacan, Tacuba, Tasco Lerma, Toluca, Pachuca, Cadereta, and St Juan del Rio, are the only other towns in the interior. Their population increases rapidly, and though some of them have mines in their vicinity, their principal dependance is on agriculture. The two towns on the coast of the Pacific Ocean are Acapulco and Zacatula. The inhabitants of the former amount to 4000 usually; but, when the ships from Manilla visit the harbour, the population is generally tripled. The granite mountains by which it is surrounded render it very sickly; though, by a large cut through them, which has created a current of air, it is rendered less noxious. Zacatula, though a good port, has but little trade; and, being to the northward, it enjoys a more healthy climate. The coast is very dangerous in the months of July and August, when tremendous hurricanes blow from the south-west; at that time, and even in September and October, the ports are difficult of access; and, even in the fine season, from October to May, impetuous winds from the north-east and north-north-east, known by the names of *papagallo* and *tehuantepec*, render the coast very hazardous. The south-west winds are attended with thunder and heavy rains, whilst the others are prevalent when the sky is clear; and what the English sailors call in the West Indies white squalls are excessively dangerous.

Intendancy of Puebla.

The intendancy of Puebla contains 813,300 inhabitants, and extends over a surface of 2696 square leagues. Its frontage towards the Pacific Ocean is

26 leagues in length, between the intendancies of Oaxaca and Mexico; but it has neither harbour nor navigable river. The greater part of the intendancy is traversed by the Cordilleras. It extends through four degrees of latitude; and, though wholly in the torrid zone, from the great inequalities of its surface, possesses the productions and the climate of every part of the globe. The table-land, which is from 5900 to 6500 feet above the level of the sea, is eminently fruitful in wheat, maize, agave, and fruit trees. It still exhibits remarkable vestiges of the ancient Mexican civilization. The highest mountain in Mexico, Pococatepetl, is in this province. It is volcanic, but for the last three centuries has only discharged smoke and ashes. It is 2000 feet higher than the highest peak of the Alps, and, with one exception, is the highest mountain of North America. The population of this district is principally concentrated on a small part of it: and almost the whole track, from the central table-land to the shores of the South Sea, though well adapted for the cultivation of sugar, cotton, and other tropical productions, is nearly a desert. The most favourable production of the elevated plain is wheat; for a long period it made but slow progress; but, as the road towards Vera Cruz has advanced, the cultivation of this grain has increased; and probably at no distant period it will become the granary for the supply not only of Cuba, Porto Rico, and the Caraccas, but of the whole West India settlements. The most remarkable objects now left of the ancient Mexicans are the mounds or pyramids, one of the largest of which is to be found in this intendancy. Its sides are exactly in the direction of the parallels and the meridian. It is constructed of alternate layers of clay and bricks. Its height is only 177 feet, but its base is 1423 feet on each side. On the top of it is a church, on a platform of 45,200 square feet, in which mass is daily celebrated, by a priest of Indian extraction. This pyramid of Cholula was used, by the former inhabitants, as a temple, or rather altar, on which human victims were offered. It was in this intendancy that Cortez laid his plans for the subsequent subjugation of the whole country, and where he found those assistances without which he could have made no efforts with any prospect of success. It had been long possessed by the two powerful republics of Tlascala and Cholula, the former of an aristocratic, the latter of a democratic kind. The latter had been recently subdued, and was not reconciled to the government of Montezuma; the former still resisted, though against fearful inequality. Cortez released Cholula from its subjection, though by the exercise of gratuitous and sanguinary cruelty; and then, having made alliance with Tlascala, the population of both states were placed under his orders, and operated that great change which the empire of Anahuac experienced. The defection of Cholula, which was the centre of knowledge, and the arbiter of the customs and religion of the country, which was resorted to by pilgrims from all parts of it, and by that means diffused its feelings and ideas, was more injurious to Montezuma than the firm hostility which Tlascala maintained. When the power of both republics were united, under the orders of such a captain as Cortez, and directed by the knowledge and valour of Europeans, it is not wonderful that the empire of Mexico perished.

Mexico.

A vegetable curiosity of most extraordinary kind is to be seen in Puebla: A cyprus tree, at the village of Atlixco, whose circumference is 76 feet 4 inches, and whose hollow trunk is 16 feet in diameter. It is unfortunate for the intendancy, that four-fifths of the land in it is in mortmain, or under Majorazgos. The greater part of it is the property of municipal, ecclesiastical, or charitable corporations, and cannot be alienated.

The principal city is Puebla de los Angelos, the most populous place of Spanish America, next to Mexico. It contains 70,000 inhabitants, by far the greater proportion of whom are Indians. The municipality, by ancient privilege, is wholly of the native race, no white man being eligible. It consists of a cacique and four alcaldes, under the control of an Indian governor, who is, however, under the command of a European intendant. Cholula, the next city, now contains about 16,000 inhabitants, mostly Spaniards, or the mixed casts, who are chiefly occupied in cultivation. Tlascala has fallen from its pristine state, and is now reduced to only 3500 inhabitants, not more than one-fourth of whom are of the original race. Thus, whilst Puebla de los Angelos, a town founded by Spaniards, is almost wholly occupied by Indians, this place, once the seat of the most numerous and warlike population of Mexico, has become deserted by the aborigines, and the white population predominates. Atlixco, Tehuacan, Tepeaca, and Huetxotzinco, the other towns, are not populous, although the farms and mines in their vicinity maintain a considerable population.

Intendancy of Guanaxuato.

The intendancy of Guanaxuato is the smallest in New Spain; but the density of its population, and its mineral wealth, more than compensate for its deficiency in extent. It extends over a surface of 911 square leagues, and contains 517,300 inhabitants, giving 586 souls to the league, a relative population greater than many countries of Europe, and much greater than in any other part of the Spanish dominions in the western hemisphere. Its rapid increase may be dated to have commenced about fifty or sixty years ago, when the rich mines of Marfel, Santa Ana, Santa Rosa, Valenciana, Rayas, and Mellado, began to yield their immense wealth. The metallic produce of these mines far exceeds the celebrated hill of Potosi, in Peru, or any other district in either continent. The riches of the mines have induced cultivation where deserts before only existed, and cities and towns have risen with astonishing celerity. No part of New Spain exceeds this in the quantity of agricultural produce, though it is all situated at a considerable elevation. Wheat and maize are beneficially cultivated, and the supply of cattle and esculent vegetables is abundant. The principal city has the same name as the intendancy, but is sometimes called Santa Fé de Guanaxuato. It is of ancient incorporation, but of recent growth, and now contains within the town 41,000 inhabitants, while 30,000 live in the mines and farms that immediately surround it. Some of the residences of the proprietors of the mines are of a degree of mag-

Mexico.

nificence and taste, which would be deemed ornamental in the finest cities of Europe. The hall of the Cabildo, the churches, and convents, are beautiful, and give to this recent city an air of grandeur and prosperity. The city of Salamanca is finely situated on the banks of the river El Grande, which runs into the lake of Chapala. Celayo and Salvatierra are cities of no great extent, but rapidly increasing, as are the towns of San Miguel, San Felipe, and Leon; all of which are of modern foundation since the great influx of wealth from the mines.

Intendancy of Valladolid.

The intendancy of Valladolid is 3446 square leagues in extent, and contains 376,500 inhabitants. It has a line of coast on the South Sea, about 38 leagues in length, but has no port or navigable river on the whole of its border. It is situated on the western declivity of the Cordilleras, intersected with hills and delightful valleys, which exhibit the unusual spectacle in the torrid zone of verdant and well watered meadows. In descending to the coast, the climate is hot and the soil arid. The most singular feature in this intendancy is the Volcano de Xorullo, or Juruyo, which was formed in the night of the 20th September 1759. The catastrophe in which this mountain rose in one night, to a great height, and totally changed the face of a great extent of country, is one of the most singular of which we have any recent and accurate accounts. Till the period of the combustion, the extent of ground between two brooks, called the San Pedro and the Cuitamba, was occupied by plantations of indigo and sugar canes. These two streams were bounded by basaltic mountains, the structure of which indicated that the district, at some remote period, had been subject to great volcanic convulsions. Fields, beautifully irrigated, formed the plantation of Xorullo, one of the richest and most prosperous in the whole province. In the month of June 1759, subterraneous rumbling noises were heard, and were attended with shocks of earthquakes, that, during an interval of fifty or sixty days, created terror in the cultivators. In the beginning of September, tranquillity appeared to be restored. The roaring had ceased, and the earthquakes were suspended. In the night between the 28th and 29th, the horrid rumbling recommenced, and with increased loudness, so as to terrify the inhabitants, who fled to the adjacent mountains. During the night, a surface of ground, from three to four leagues in extent, swelled up like an enormous bladder, in a convex form, whose elevation, in the centre, was 520 feet above the level of the ground from which it rose. Those who saw the awful spectacle assert that flames issued forth for an extent of more than half a square league; that fragments of burning rocks were thrown to prodigious heights; and that, through a cloud of thick ashes, when illumined by the volcanic fire, the softened surface of the earth was seen to lift itself up like the waves of the sea. The two rivulets ran into the fiery chasm, and the decomposition of their waters contributed to invigorate the flames. Eruptions of mud, and especially strata of clay and basaltes, in concentrical layers, indicated that subterraneous water had a great share in producing this extraordinary convulsion. Thousands of small cones, from six to ten feet in height, were projected from the surface, which became a kind of funnel, from which a thick vapour ascends to the height of from forty to sixty feet. In many of them a subterraneous noise appeared to indicate the proximity of some fluid in a state of ebullition. In the midst of these cones, or, as they are named by the inhabitants, ovens (*hornitos*), six large masses were protruded to the height of from 1300 to 1650 feet above the old level of the plain; the most elevated of which now forms the volcano of Xorullo. It is constantly burning, and has thrown up from its north side an immense heap of scorified and basaltic lavas, containing fragments of primitive rocks. The great eruptions of the central volcano continued till February of the following year, when they began gradually to diminish. The country has ever since obtained the very appropriate name of *Malpays*. The terrified inhabitants, who had retired to a distance of between seven and eight leagues, became gradually reconciled to the spectacle, and having returned to their cottages, beheld, with admiration, the streams of fire issuing from a vast number of great and small apertures. Although the subterraneous noises now appear by no means violent, and the Malpays, and even the great volcano, begin to be covered with vegetables, yet the ambient air is so heated by the action of the small ovens, that the thermometer, in the shade, at a great distance from the surface, rose to 109. The traveller is still shown the two brooks, whose clear streams formerly watered the plantation, bursting forth at a distance of more than a mile from the spot where they were enveloped in the chasm created by the volcano. These streams, if the same, are now united in one, and are of the temperature of 126. There is near them a sulphurous stream, more than 22 feet in breadth, the water of which is most highly impregnated with that mineral. The belief among the more rude Indians in the vicinity is, that the convulsion was a miracle wrought by some Capuchin friars, who had preached, but without effect, to their tribes; that being thus rejected, they poured forth imprecations, and declared that the plantation should be first destroyed by earthquakes and volcanos; and that when the latter were burnt out, the climate would gradually cool, till, from being perpetually buried in frost and snow, it would become totally uninhabitable. As the first part of the prediction has been fulfilled, and as the gradual coolness has been increasing, they live under a strong impression that the latter will also be accomplished, thus expecting an impossibility, because a natural, though unusual, operation of nature has taken place. The industry of the monks, in making converts among the Indians, is very great; many of them are constantly employed in the work, and their anxiety to succeed in it is such, that they seldom fail to avail themselves of any natural occurrence that can be made subservient to their views.

The Indians, who inhabit this province, are of three different races, and each retains its original language;—the Tarases, who were famed in the sixteenth century for their industry, and the advancement they had made in the mechanical arts; the Otomites, who are remarked for their low degree of civilization, and their peculiarly gut-

Mexico. tural language, which was noticed by Cortez at the first discovery; and the Chichimecs, who, like the Tlascalars, have preserved the ancient language spoken at the Aztec court. The whole of the north part of the intendancy is inhabited by these tribes, who preserve their ancient separation, if not their enmity. They are, however, all Christians, and the only white man seen in their villages is sometimes a priest, though even the ecclesiastics are more frequently of the Indian or Mestizo race. The benefices are so poor, that it is with difficulty any of the clergy can be induced to reside in a country where no Spanish is spoken, and which on the sea coast is so unhealthy, that, the priests frequently die of malignant fevers within six or eight months after their induction. The population of this intendancy decreased very much in the year 1786 and 1790, when the country, from long drought, was visited by scarcity approaching to famine. The suffering of the inhabitants would have been much greater, but for the humanity of the bishop of the diocese; who, at a loss of more than 50,000 dollars to himself, procured maize from the neighbouring provinces to feed the poor.

The principal city, Valladolid de Mechoacan, contains about 18,000 inhabitants; it is the see of a bishop, and the residence of the intendant. The town-house, churches, and convents, are handsome, and the public walk, the *Alameda*, celebrated for its beauty. Pascuaro, the next city, is finely situated on the border of a lake of the same name. It contains 6000 inhabitants, mostly Indians. A former bishop of Valladolid is interred here, Vasco de Quirago, who was distinguished by his humanity to the Indians, and by the skill with which he inspired them with the practice of industry: he died in 1556, but his memory is preserved by the rude tribes, who still call him their father. The only town besides is Huitzitzilla, with 2500 inhabitants. Some of the mines are very valuable, particularly those of Zitaquaro and Real dei Oro.

Intendancy of Guadalaxara. Guadalaxara is an intendancy extending over a surface of 9612 square leagues, and maintaining a population of 630,500 souls. It stretches 123 leagues along the shores of the Pacific Ocean, where it has the single port of St Blas. It is crossed from east to west by the Santiago, a considerable river, which rises on the lake Chapala, and empties itself into the Pacific Ocean, near St Bas. It is a most important means of communication between the interior of the country and the sea, and though now only used for floating timber to the naval arsenal, is capable of being made the route for the productions of Salamanca, Guanaxuato, and Zelaya, to the ocean. The volcano of Colima in this province rises to the height of 9200 feet above the sea; but the plain on which it stands being 5500, its appearance is not striking. No eruption of it is recorded, but it frequently throws up smoke and ashes. It is the most westerly of all the volcanos of New Spain. This intendancy is both an agricultural and manufacturing district: according to the statement made by the intendant, the value of its annual agricultural produce amounted to 2,599,000 dollars, and that of its manufactures to 3,302,000. Maize, wheat, and cotton, are the principal productions of the soil, whilst the manufactories furnish cloth from cotton and from wool, both for the inhabitants of this district and some of the surrounding ones. One of the most productive mines of New Spain, that of Balanos, is within this intendancy, besides which are Asientos de Ibarra, Copala, Guichichila, and several smaller ones. The city of Guadalaxara is the residence of the bishop and of the intendant; and the highest court of justice, the Royal Audience, has its sessions in it. It is a corporation with a cabildo. The edifices are some of them very magnificent. The population in 1793, according to Humboldt, was 19,500; but by an account now before us taken in 1809, it appears to amount to more than 40,000. The only other city, St Blas, if it were not unhealthy, would at some time become a port of vast importance. It is the best harbour on the western shore of Mexico. It has an inland communication by means of the river St Iago. The country about it is well covered with excellent ship timber. Pitch, tar, and turpentine, are to be procured with facility, and hemp and flax grow as far as they are permitted almost spontaneously. It is already the principal arsenal for building ships, and the chief place where the few ships of war, belonging to Spain, in those seas are refitted. It was in the contemplation of the government to concentrate their naval affairs by conveying the stores of St Blas to Acapulco, but the superior advantages of the former port has induced the continuance of it as an arsenal.

The intendancy of Zaccatecas contains 2350 square leagues, and a population of 153,000 inhabitants. Its dependance is almost wholly on the rich mines which it contains. The table-land, which forms the centre of the district, is composed of sienite, on which strata of primitive schistus and schistous chlorites repose. The schist forms the base of the mountains of grauwacke and trappish porphyry. There are nine small lakes to the north of the capital, which abound in muriate and carbonate of soda, especially the latter. This carbonate is of great use in dissolving the muriates and the sulphurets of silver. The central table-land of Asia does not abound in soda more than this part of Mexico. Some of the richest silver mines are worked in this province, where was discovered the *veta negra de Sombrete*, the richest seam that was ever discovered in either hemisphere. Zaccatecas, the chief place, contains a population of 33,000 inhabitants. Sombrete and Fresnillo are large well-inhabited places, and increasing as the productiveness of the mines which they surround increases. Intendancy of Zaccatecas.

The intendancy of Oaxaca is one of the richest in New Spain; its extent is 4447 square leagues, and its inhabitants amount to 535,000. Its southern boundary extends along the coast of the Pacific Ocean from Guatimala to the province Puebla, a distance of 110 leagues. Oaxaca is one of the most delightful countries in this quarter of the globe. The beauty and salubrity of the climate, the fertility of the soil, and the variety and richness of its productions, all minister to the prosperity of the inhabitants, who have, in consequence, from the most remote period that we are acquainted with, been the Intendancy of Oaxaca.

Mexico.

most advanced in civilization of any portion of New Spain. The mountain soil of this province forms a singular contrast with that of the adjoining districts. In place of the strata of basaltes, and amygdaloid, and porphyry, with grünstein base, which cover the other regions, only granite and gneiss are found in these mountains. The height of these granite summits are not ascertained, but the Cerro de Senpualtepec is said to be the loftiest, and from one of its heights both the seas are to be seen. This intendancy comprehends two mountainous districts, called Mixteca and Tzapoteca. The Indians of the former, who principally cultivate the nopal for the cochineal insect, are an active, intelligent, and industrious race of people. Some ancient cemeteries which exist, though in ruins, show that the inhabitants of this district, before it was known to Europe, had made more progress than the other natives of this continent. The palace of Mitla was appropriated as a retirement for the sovereign, to lament for the loss of a wife, a mother, or a son. It forms three edifices, the principal of which is best preserved, and is 130 feet in length. A staircase formed in a pit leads to a subterraneous apartment, 88 feet by 26. This gloomy place is covered with *Grecques*, the same as the exterior walls of the palace. The most material distinction between this and other Mexican edifices is, its having pillars of porphyry to support the ceiling; they are 17 feet high, and the shaft is a single piece. The similarity of the apartments to those found in Upper Egypt is very striking. This province gives the title of marquis to the family of Cortez, and the majorazgo belonging to them consists of four towns and forty-nine villages, which contain 17,000 inhabitants. The principal city, Oaxaca, but sometimes called Antequera, contains about 24,000 inhabitants. It is the residence of the bishop, of the intendant, and the court of justice. It is well built, and was, till the late disturbances, when the insurgents entered and plundered it, a most rapidly improving place. San Antonia de los Cues is a populous place, and carries on a considerable trade. The only port is Teguantepeque, at the mouth of a river, whose bar impedes the entrance of large vessels. It is, however, the channel by which the indigo and other valuable products of Guatimala pass into the river Huascualco, in their way to the European markets. The most considerable mines are Villalta, Zolga, Yxtepexi, and Totomosla, but their produce is inconsiderable, when compared with the richer veins to the northward.

Intendancy of Merida.

Merida is an intendancy of New Spain, though it comprises only the peninsula of Yucatan, which formed no part of the ancient empire of Mexico, and is now in part inhabited by a few straggling British subjects, and a numerous body of unreclaimed Indians. Its extent is 5977 square leagues, and its population is estimated at 465,000, the far greater part of whom live an errati life. Cape Catoche was once probably joined to Cape Antonio, in the Island of Cuba; but the period when the impetuous force of the ocean burst the barrier, and formed the Gulf of Mexico, must be more a matter of conjecture than either of history or of calculation. The peninsula has a ridge of high mountains in the centre, which divides the part to which the English have access from the Spanish inhabitants. The western side of this range alone is, strictly speaking, under the Viceroy of Mexico, who has issued orders for the Indians under the authority of Spain to be removed to such a distance as shall prevent their assisting in contraband trade. The soil of this peninsula, when cultivated, is fertile, and yields the subsistence and subjects of commerce which a tropical climate usually affords. Its hills abound with cattle, whose hides and tallow constitute part of the exports. The climate, especially in the hills in the centre, is salubrious, and refreshed by the sea breezes. Campeche is the principal place of commerce, but the whole shore is so flat, that vessels cannot approach within six or seven miles with safety. Its inhabitants are estimated at 7000 or 8000. The town of Merida is on an arid plain, forty miles from the coast. A small river passes it, and enters the sea at a part which can scarcely admit the entrance of large boats; what little commerce it enjoys is by this channel. Its exports consist principally of honey, wax, and an inferior kind of cotton; but the latter article, owing to the want of machines for clearing the seed from the wool, is of very little value. The population of the town is 10,000 souls. Besides these, there is the small town of Valladolid, with about 2500 inhabitants. The rest of the population is scattered in small villages, or spread in wandering tribes. The wood, which takes its name from one of the towns of this province (*Campeche*), is found in great abundance. It is suffered to dry for one year after it is cut down, when it is usually carried to Vera Cruz or Havana, to be conveyed to Europe. The expences of its conveyance are so great, in proportion to its value, that it is scarcely worth converting into an article of commerce. There are no mines of any description in this intendancy.

Intendancy of Vera Cruz.

The intendancy of Vera Cruz is a narrow strip of land extending along the coast of the Gulf of Mexico, from the river Baraderas or de los Largatos, to the great river, or rather the estuary of Panuco. Its length is 210 leagues, whilst its breadth is only from 25 to 28 leagues. Its whole surface is an extent of 4140 square leagues, and its population no more than 156,000. Having already, under the division of commerce, taken a view of its most important depot, the city of Vera Cruz, the capital of this intendancy, we pass on to the description of its interior. There is no region of even the new continent where the change and variety of climate and production is so abrupt as in this province. The high and snowy mountains approach almost to the shore, where the intense heat of a vertical sun is felt with the fullest fervour. The western side of this district forms the acclivity of the table-land of Mexico, and the ascent is so sudden, that, in the short space of a single day, the traveller from the plain above may, from the regions of eternal frost and snow, reach the level ground on the shore of the ocean, where the most suffocating heats prevail. In ascending to the upper plain, the increase of elevation is distinctly marked by the different trees, and other vegetables, and by the modes of cultivation which the peasantry pur-

Mexico.

sue. The growth of the oak points out the limit which nature has assigned to the dreadful fever of the low country. When the region where that tree grows is once gained, the apprehension of infection from the contagious disease of the warm climate may be at rest. In ascending to Xalapa, 4300 feet, the forests of liquid-amber announce that the traveller is in the region where the clouds from the ocean come in contact with the basaltic summits of the Cordilleras. A little higher, the banana tree, whose fruit induces indolence in the native of the hot climates, ceases to be productive, and thus compels the peasant to a more laborious kind of cultivation. At the height of San Miguel, pine trees begin to mingle among the oaks, and gradually increase to Perote, at the elevation of 7700 feet, where the eye of the traveller is first regaled by the spectacle of extensive fields of wheat. A thousand feet higher the climate forbids the growth of the oak, and only pines are to be seen, which clothe the mountains till they penetrate the region of perpetual snow. The coast of Vera Cruz is very thinly inhabited; this may in some measure be owing to the insalubrity of its climate, though no more can be owing to that cause there, than in the other tropical regions; but as the coast is the frontier against a naval enemy the only one that New Spain could dread, the military service in the militia demanded from the inhabitants was much greater than in the cooler regions, [illegible] much less oppressive, [illegible] the coast to escape the [illegible] lancers and cavalry. [illegible] spot on the globe, yet [illegible] been exposed to a want of provisions [illegible] scarcity of labourers in its vicinity [illegible] small portion of work which its products [illegible] demands.

In this province [illegible] two mountains of great height. The volcano of Orizaba is 17,300 feet above the level of the sea: it resembles a truncated cone, and a crater, which inclines towards the south-east, is visible at a prodigious distance. Its upper part is always covered with snow. Smoke constantly ascends from it, but it has not terrified the inhabitants by an eruption within any known period. The Coffer of Perote, another mountain, and which, with Orixaba, serves as a guide to mariners in approaching the coast, is 13,500 in height. On its summit is a square mass, resembling a large chest, from which its name has been obtained. No crater is to be seen upon it, nor are any eruptions recorded, but currents of lava, near some villages in its vicinity, appear to indicate that at some distant period there must have been a lateral explosion. A volcano at Tuxtla, to the southward of Vera Cruz, has had frequent eruptions within recent periods; one, in March 1793, was very considerable, the houses in Vera Cruz, Oaxaca, and Perote, were covered with ashes, and at the latter place, though a distance of 180 miles, the subterraneous noises which were heard there at the same time resembled heavy discharges of artillery. There are no mines at present worked in this intendancy; some were formerly explored, but, after being ascertained to be too poor to be profitable, they have been abandoned. Some medicinal productions, of more value to the physician than to the merchant, are collected in this intendancy. The root of the Convolvulus jalapae is found near the city, from which it has received its name. Sarsaparilla is also found in plenty in the humid and shady ravines of the Cordilleras. The royal monopoly of tobacco is supplied with part of its consumption from the vicinity of Cordova, and creates a large portion of that productive branch of revenue. The city of Vera Cruz is the capital of the intendancy, and to what has been already noticed concerning it, it will be sufficient to add that its population is 16,000 inhabitants, and that the public buildings and houses are all built of materials drawn from the bottom of the ocean; a species of madrepones and petchistein, as there is neither stone nor clay in the neighbourhood. Water is very scarce and brackish so that most houses are provided with tanks for holding the rain, which falls in most copious showers, or rather torrents, at some seasons.

Xalapa, or Jalapa, is a city rather more than half the height of the central table-land. The climate being good, it is the resort of the richer inhabitants of Vera Cruz, when their commercial affairs do not demand their personal attendance. The sky is serene and beautiful in summer, but from December to February it wears a most melancholy aspect. When the north winds blow at Vera Cruz, the inhabitants of Xalapa are enveloped in a thick fog, the thermometer falls to 60 or 61, and for several weeks the sun and stars are utterly invisible. In the other parts of the year, when the heats on the coast are intolerable, and the sufferings from insects highly annoying, the residents at Xalapa enjoy all the delights that the most voluptuous climate can afford The buildings in this place are spacious, and partake of that character of magnificence which is prevalent in New Spain. Some attention to study and to the fine arts is paid; and there is a School of Drawing, in which children of the poorer artisans are instructed, at the expence of the richer inhabitants. The population amounts to about 11,000, the greater part of whom are whites.

Perote is a fortress rather than a town, and in it the treasure destined for Europe is usually lodged, to wait a secure means of conveyance. In time of war, it is said to have contained at one time more than 40,000,000 of dollars, waiting an opportunity of being conveyed to Cadiz. It is nearly 8000 feet above the level of the sea, and in a country peculiarly barren.

Cordova is a large town, in a good climate on the eastern declivity of the Pic de Orizaba, whose inhabitants about 6000 are mostly employed in the cultivation of tobacco; as are those of Orizaba, another town of nearly the same population, a little to the eastward of Cordova. The inhabitants of these two places had a contest of many years continuance, respecting the course of the new road from Vera Cruz to Mexico. After much intrigue, many law-suits, and much bribery, a road was begun, and is now proceeding from Perote to Xalapa, and from thence to the bottom of the mountains near Vera Cruz, which, when completed, will have a powerful effect on the future condition of the whole viceroyalty. There are many smaller towns on the more elevated

Mexico.

parts of the province, which is indeed by far the best peopled division of it; but in the border on the sea-coast there are merely plantations, *haciendas* or grazing tracts, *ranchos*, with none but the necessary labourers which the two species of establishments require.

Intendancy of San Luis Potosi.

San Luis Potosi is the largest intendancy in New Spain, and, like the other northern parts of the viceroyalty, very thinly peopled. Its extent is 27,260 square leagues, and its population 335,000. Though this extent is mentioned, it is by no means to be relied upon, for the limits to the north have never been ascertained with any tolerable accuracy, and the greater part has never been explored by any but the native Indians. A considerable district lying between the rivers *Conchos* and *Bravo del Norte*, called Bolson de Mapimi, extending over 3000 leagues, is occupied by tribes of Indians called Apaches, who make perpetual incursions on the Spanish settlers in Coahahuila and New Biscay. San Luis Potosi, from its southern extremity to the ridge of mountains which separate it from the *provincias internas* (which will be presently noticed), presents a regular declivity; beginning at the table-land of Mexico, and with a gentle descent terminating near Saltillo, where the only opening in that range of mountains is to be found. The southern part is a country whose mines are very productive, and in the northern they are supposed to be equally rich, but the want of capital and the thinness of the population have hitherto prevented them from being explored. The southern part is fertile and cool, with the exception of some of the deepest valleys and the highest mountains. Wheat is grown sufficient for the higher class of inhabitants, but the poorer classes use bread made from maize. The whole country is well supplied with animal food, either from itself or from the *provincias internas*. As there are no settlements between the river Sabina and the mountains which divide it from Texas, this province contains 1500 square leagues without habitations, and most parts of the district present nothing but impassible marshes. Mr Lalond, a French engineer who passed through this country, states, that eight leagues north of Chichi there are hills which abound in coal, from which subterranean noises resembling discharges of artillery are frequently heard. It occupies ten or twelve weeks to travel from the city of Mexico to the frontiers of this intendancy, and the greater number of nights, from want of habitations, must be passed in the open air. The city of San Luis, the capital, contains a population of 12,000 inhabitants; being the seat of the board of revenue for the *provincias internas*, it has considerable intercourse with them. The mines of Catorce have only been worked since 1778, but they now hold the second or third rank among those of New Spain. These mines are in rocks easily worked, and requiring but a small supply of gunpowder to blast them. They have, too, the great advantage of being free from water almost altogether, so as to need no costly machines to discharge it. The town of Catorce, situated near the mines, and depending on them, has risen with great rapidity from an obscure Indian village, to be a large and flourishing place, and though not yet dignified with the title of city, it is much larger than many other places so incorporated.

Mexico.

Though the intendancy of San Luis Potosi extends over the four provinces of Leon, Santander, Cohahuila, and Texas, those divisions are no part of the viceroyalty of New Spain, but are under a chief independent of its control, though, in affairs of revenue, they are accountable to the intendant of St Luis, and in law processes their last appeal is to the court of royal audience in the city of Mexico. As these provinces are but little known to Europe, were but slightly noticed by Humboldt, and yet promise at no distant period, both from their natural properties, and from their local situation, as the frontier towards the United States, to be subjects of considerable interest, we shall describe them according to the *Memorial* which their delegate to the Cortez at Cadiz, Don Miguel Ramos de Arispe, presented to that body.

These four provinces occupy two hundred and twenty leagues of shore on the Gulf of Mexico. Though none of the ports are good, and all have bars at their mouths, yet they are capable of considerable improvement, and probably would be improved, if greater freedom of commerce were allowed them. The harbour at the mouth of Rio Bravo del Norte, called *El Brazo de Santiago*, is the best on the coast. It has never less than thirteen feet water at its entrance, and as the tide sometimes rises three feet, it would admit vessels, properly adapted for it, of 400 tons. It is defended from the prevailing storms by the island Malahuitas. The river is already navigable forty leagues upwards, and might be made so, with very little exertion, thirty leagues higher. The port of San Barnardo, in lat. 27° 30′, was, indeed, in 1808, decreed to be opened for admitting vessels either from Spain or the colonies, but up to March 1812, only three small sloops had entered it, and owing to some jealousies of the officers of government, the restrictions on commerce were such as to forbid the hopes of increase. *El Soto de la Marina*, a port now closed by authority, in 24° 29′ of north latitude, if it could be opened, would be improved by its own inhabitants, who are anxious to be allowed to do so. These four extensive provinces are separated from the other dominions of Spain by ridges of mountains which are impassable in most parts by horses, and totally so by wheel carriages, except at the single chasm where the city of Saltillo is built, and which has, in consequence, become the focus of all communication. Their intercourse with each other is maintained with great facility, both by means of their rivers and their extensive and rich plains; and they can exchange their different productions without encountering those difficulties which almost exclude communication with New Spain. Coahuila, the largest of the provinces, is the southermost, and divided from San Luis Potosi and Zacatecas by the Cordilleras before noticed. It is 200 leagues in length, and 100 in breadth. Its situation is generally elevated, and being well sheltered from the north-west winds, its climate is generally healthy, not too hot even in the summer, nor severely cold in the winter months. Its surface is most luxuriantly irrigated by the numberless springs which burst from its hills, and

 produce rivulets that contribute to increase the waters of the great river Bravo del Norte. The water of these springs is generally pure, from mineral solutions, and is pleasing to the taste, but some are impregnated with sulphur, and are used for medicinal purposes. Its pastures are clothed with rich natural grasses, and admirably calculated for breeding, rearing, and fattening cattle; and its forests furnish abundance of wood, well calculated for every kind of construction. There are mines of saltpetre, copperas, alum, lead, tin, and copper, besides some silver in Santa Rosa, and gold in Sacramento. These mineral treasures, for want of population and capital, have been rather ascertained than explored. The inhabitants are almost wholly of the white race, or with such slight mixture of the Indian blood, as to make no distinction in colour worthy of notice. The native tribes within the province have been extinguished; but, on the borders, they have the warlike nations of the Lipanes and Cumanches to the north, and the Apaches and Mescaleros to the west. The principal town, Saltillo, contains 6000 inhabitants; it is the seat of the fiscal branch of the government for the four provinces. An annual fair is held at it, to which great crowds resort, and exchange their produce for the few articles of European luxury, which their high prices and the poverty of the inhabitants enable them to obtain. Monclova is deemed the capital of the province, because it is the head-quarters of the military; but the governor-general resides at Chihecahua, in New Biscay. He is independent of the viceroy of Mexico, and has equal power throughout the four provinces, except in matters of finance, and in legal decisions. Cohauila contained betwixt 70,000 and 80,000 inhabitants in 1811. They are solely occupied in agriculture, and produce excellent wheat and barley, and great variety of fruits. The vines cultivated here make wine of very excellent flavour, and considerable strength, and, if admitted into New Spain, would be a valuable source of riches. The province of Texas began to be peopled from Cohauila, in the middle of the last century. San Antonio de Bejar, the principal place, is called a city, as are Espirito Santo and Nacodoches; but all have a very small population. In each town, a troop of cavalry is established; and, since 1806, detachments have been posted on the rivers Guadalupe and Trinidad, and in the port of Arcotaisas. On account of the pretensions of the government of the United States, a body of militia of 700 men has been kept constantly in active service in this province, and they, with their families, have contributed to extend cultivation and to increase the population. The plains in this province are cultivated with indigo, coffee, and sugar, but to very trifling extent; and they produce zasafras, snake-root, and some other drugs. Mines are said to exist, but none are worked.

The province of Leon, or, as it is pompously designated by the Spaniards, the New Kingdom of Leon, is one hundred leagues in length, and fifty in breadth, all in a low and hot climate, except the town of Rio Blanco, and the Valley de Labradores, which are beyond the mountains, and with difficulty approached from the other parts of the province. Its soil is generally fruitful, and abounds in excellent pastures, on which numerous cattle are bred. It produces abundance of corn and fruits; and mines of lead, tin, and copper, are slightly worked. The inhabitants affirm, that it has several rich mines of silver and gold, but they are too poor to work them. The city of Monte del Rey is the capital; it is the residence of the bishop, who has spiritual authority over the four provinces. There is in it a college, a cathedral served by seventeen priests, an hospital, and a convent of Franciscans. The capital contains 9000 souls. There is another city, Linares, and several towns, but they cannot be large, as the whole population of the province only amounted to between 70,000 and 80,000 inhabitants.

The province of Santander, like that of Leon, only began to be peopled about fifty years ago. As part of this province is on the coast, it is warm, but in general healthy, the air being free from humidity, and cooled by the trade wind in the day, and the land wind at night. The more elevated parts are cooler, but the mountains are not of that immense height, as to be intolerable even on their summits. The country is well irrigated, and the soil well calculated for every production of all climates. Its mines of tin, lead, and copper, are affirmed to be rich, and the ore of the latter is said to be the nearest to the pure metal of any hitherto discovered. The inhabitants amount only to between 60,000 and 70,000: Horcasitas, the capital, contains about 5000; the remainder are distributed in several smaller towns, and in numerous villages and farms, and are wholly employed in the affairs of agriculture. This province abounds with excellent horses, with which part of Mexico is supplied; they are of an active make, accustomed to perform long journeys, and, what is of vast consequence, when the use of shoes is not introduced, with very hard hoofs. The sheep have multiplied in an extraordinary degree, for the short period during which these provinces have been settled. They not only suffice for their own consumption, but supply the markets of Zacatecas, Queretara, Mexico, and Puebla, notwithstanding their immense distance. Notwithstanding the riches of the soil, and the salubrity of the air, the inhabitants of these provinces have made no progress to be compared with that of those who have proceeded from the United States, into the western part of the Continent, or to the British province of Upper Canada. This may be accounted for in some measure from the want of capital in the settlers; for it appears that they are obliged to sell their cotton, as well as the wool from their sheep, to the people of the south, as soon as it is collected, from not having money to pay for weaving it at home. Some manufactories have commenced at Saltillo, where about forty looms are at work; but such is their poverty, that they are obliged to sell every week what they produce, that they may purchase a supply of wool to work with in the subsequent week. Although this want of capital is a great impediment, it might be, and would be surmounted, if the bad policy of the government did not tend to keep them from improvement. Being prevented, by the system adopted in many parts of the Spanish dominions, from having direct intercourse

Mexico. from their own ports with any other, all they want comes loaded with heavy duties and charges, and what they have to dispose of comes to the consumer with similar additions. In these kind of transactions the tax called *Alcavala*,—a duty on the sale of every commodity, is felt with peculiar pressure. This is strongly stated by Don Miguel Ramos in his *Memorial*.

"There is no open port for all the opulent kingdom of Mexico," he says, "but that of Vera Cruz, which has a most scandalous monopoly of all European goods. These goods at Cadiz are the second hand, Vera Cruz is the third, Mexico, Queretara, or Zacatecas, the fourth, the great fair of Saltillo is the fifth, thence they are spread every year to the dealers of the interior, which makes the sixth hand, and then to the consumer the seventh. These goods have to their original cost added the duties of export at the place from whence they are first sent; of importation and of exportation at Cadiz, of various duties at Vera Cruz, of the *Alcavala* there, the same at Mexico, at Saltillo, and the other dealers through whose hands they pass. To this must be added the expence of freights and carriage, and the profit of each dealer through whom it has reached the poor consumer. The *Alcavala* is even levied on the last purchaser, and with such tyranny and cruelty, that the poor labourer is compelled to pay it on the emnants of cloth he buys at Saltillo to cover his naked family; and the small quantities of rice, flour, or beans, which he sells there must bear the same costly expences of freights, profits, and *Alcavalas*. Whilst the merchants of Cadiz, of Vera Cruz, of Mexico, and of Saltillo, gain, the heavy weight of the duties and charges falls upon and impoverishes the poor cultivator, in the *provincias internas*."

It seems to have been the weak policy of Spain to make government precede, and not follow, population; to appoint officers of revenue before there are inhabitants to pay it; to build churches, and remunerate the clergy, before any worshippers are collected; and to appoint military commanders before any troops can be mustered. The policy, both of Great Britain and the United States, has been directly the reverse. As their subjects have proceeded to cultivate the deserts, they have been left to themselves; and when, by their increase in numbers and in wealth, which, on good soils, has been with great rapidity, they have felt the want of government, laws, religious institutions, or armed protectors, they have either been supplied to them, or their necessities have compelled them to provide those requisites from their own resources. In one case, nature has been left to her own course, and she has converted the desert woods into cultivated fields and populous cities; in the other, art has been exercised where it was unnecessary, and the consequence has been a slow, languid, and doubtful progress, accompanied with arduous struggles for even the necessaries of existence.

Intendancy of Durango. The intendancy of Durango, or, as it is more usually called, of New Biscay, has an extent of 16,873 square leagues, and a population of 160,000 inhabitants. The northern border of this province, for more than 200 leagues, is inhabited by warlike and independent Indians. The Acoclames, the Cocoyames, the Apaches, the Mescaleros, and Fardones, possess the Bolson and mountains of Chamante, on the left bank of the Rio del Norte. The Membrenos are farther to the west, in the wild ravines of the Sierra de Acha. The Cumanches, and the numerous tribes of Chechimecs, included by the Spaniards in the general and vague term of Mecos, disturb the inhabitants of New Biscay, and compel them always to travel in large bodies, or well armed. The military posts (*presidios*) on the frontiers, are too far from each other to intercept the excursions of these savage tribes, who are well skilled in all the stratagems of petty predatory warfare. The Cumanches are the mortal enemies of the Apaches, some of whose tribes live in peace among the Spaniards, and are formidable foes to the colonists of New Biscay. They have learnt to tame the horses, which have increased to wildness since the Europeans have settled in the country, and they are become expert and agile horsemen. The Cumanches, like all the savages who range extensive savannas, are ignorant of their original country. They wander over the plain accompanied by large dogs, whom they have trained to carry their tents, made of the hides of the buffalo. These savages are most to be dreaded on account of their cruelty, as they murder all their adult prisoners, and carry away the children, whom they preserve for their slaves. The Indian tribes on this frontier are certainly on the decrease; and, within the last twenty years, their inroads have been fewer. Their hatred to the whites is, however, unabated; and though the frequent want of success may have lessened their hopes, it has not diminished either their animosity or their courage. They have concentrated themselves in the vicinity of Moqui, and in the mountains of Nabajoa, and have driven away the Spanish colonists. The evil effect of being thus stationary in a strong country will be long felt, and prevent their becoming more civilized; as the spirit of revenge which Indians peculiarly imbibe will act as an obstacle to their intercourse with the Europeans, or with those tribes that live among them. If the same races of Mexican Indians existed in New Biscay as in the table-land of the viceroyalty, the wild tribes would be more likely to become gradually conciliated by them than by Europeans alone. But, in New Biscay, there are no Indians who pay the tax, and are thereby freed from the alcavala. All are whites, or so nearly approaching to that race, that they are accounted such.

This perpetual state of warfare with the Indians, which has long endured, by which the colonist, in his lonely farm, is under the necessity of being always watchful and always armed, has given to the inhabitants of the frontiers a degree of courageous energy, and a temperament of a peculiar kind. The climate is favourable to corporeal strength, and these causes have created a race of borderers who endure hunger, suffer fatigue, maintain watchfulness, and exhibit courage, which, though now only called forth by predatory warfare, would become powerful means of defence if they should be involved in warfare with the descendants of other Europeans, advancing towards them from the United States. This strength

Mexico.

of body is said, also, to be productive of strength of mind, and a happy disposition of the intellectual faculties. Those who superintend the seminaries of Mexico have remarked that their most distinguished students in the exact sciences have been natives of the most northern provinces of New Spain. Durango is a mining country, and consequently furnishes both capital and consumers to the agriculture, which, for the paucity of the inhabitants, is in a flourishing state. Near the better-peopled division of the country, wheat is grown sufficient for those who prefer it to maize, which is, however, the common food of the greater proportion of the inhabitants.

The climate is generally temperate. In even the more settled parts, snow is not unusual in the winter, and the thermometer descends frequently below the freezing point to 14° of Fahrenheit. A singular group of rocks is seen near the capital, which have engaged the attention of mineralogists. The basis of these rocks, called La Brena, appear to be basaltic amygdaloid, which seem to have been raised up by volcanic fires. They are covered with scoria. They are in the midst of a level plain; are twelve leagues in length from north to south, and six leagues in breadth from east to west. They are of a most grotesque form; and, on the summit, there is a crater 320 feet in circumference, and 100 feet in depth. Near these rocks, a remarkably large mass of iron is found in the midst of a level plain; it is probably an aerolite. Its weight, calculated by its size, is 17 tons 9 cwt. The city of Durango is the residence of an intendant, and of the bishop of the diocese; its population amounted to about 12,000. Chichuahua, San Jose del Parral, and San Juan del Rio, contain about 10,000 each; and there are several smaller towns, many of which derive their names, as well as their existence, from the mines near which they have been built.

Intendancy of Sonora.

The last intendancy of New Spain is Sonora, extending over 19,143 square leagues, and inhabited by 121,400 persons. From the proportion between its extent and population, it will naturally be inferred, that a very small portion only of it is cultivated. It extends through ten degrees of latitude on the Pacific Ocean and the Gulf of California. In some parts it is not more than 50 leagues in breadth, and in others 120. The post from Mexico to California passes through this district on horseback, and crosses the gulf in a launch to Loreto, or Old California. The whole distance traversed by the courier with correspondence from Guatimala to San Francisco, in New California, is upwards of 3000 miles. The northern part of Sonora is chiefly inhabited by a numerous Indian nation, called the Pimas. They mostly live under the direction of missionary monks, and are followers of the Catholic rites and ceremonies. In the ravines of this mountainous country much gold has been found, sometimes in very large grains; but the washing places are subject to incursions from some unreclaimed Indians, which prevent their yielding to the extent they would do under other circumstances. There has been hitherto no permanent intercourse between Sonora, New Mexico, and New California. The government has directed chains of missions to be established to preserve the communication, but its efforts have been fruitless. Two monks of the propaganda of Queretaro have recently been enabled to traverse the whole country from Monterey to San Francisco, without crossing, as is commonly done, into any part of California. Father Garces and Father Font departed from Horcasilas, and in eleven days reached an extensive and beautiful plain, at one league distant from the southern bank of Rio Gila, where they discovered the Casa Grande; the place at which the Astec nation rested many years, in its progress from the north to the place where it finally settled. It is constructed of rammed clay in squares of unequal sizes, but symmetrically placed. It is a square, each of whose sides is 445 feet and parallel to the cardinal points. The walls are four feet in thickness. The edifice had three stories and a terrace, and the staircase was on the outside. A wall, on which were square towers, surrounded it, and appeared to have served for purposes of defence. There are vestiges of an artificial canal from the river for supplying it with water, and the whole surrounding place is covered with fragments of earthen pots and pitchers, some of which are neatly painted with red or blue. There are besides found many pieces of the volcanic glass, or obsidian, which was used when the Spaniards first visited Mexico for mirrors, as well as for razors, knives, and arms. This is deemed by the Mexican antiquaries to be a decisive proof, that those who emigrated to this place came from some more northern region, where the volcanic production is profusely to be found. Those Indians who inhabit the plains near the river Gila, by no means deserve the appellation of savages, though they never had, before these missionaries visited them, any communication with the inhabitants of Sonora. They were found in villages of two or three thousand persons, were comfortably clothed, and had fields cultivated with maize, cotton, and gourds. The missionaries, in order to convert them, exhibited a large picture, painted on a cotton cloth, which represented a sinner burning in the flames of hell. It terrified them, and they requested the fathers not to unrol it again, or to speak to them of what would happen after death. These Indians are of a mild and sincere character. When the missionaries explained to them, by an interpreter, the security which prevailed in the Christian missions, where an Alcalde administered justice; the chief replied, "This order of things may be necessary for you, but we do not steal, and we very seldom disagree; what use then have we for an Alcalde among us?" The most considerable places in this intendancy are Sonora, the residence of the bishop, and Arispe, each of which contains a population of 7000 or 8000; but Cinaloa, Culiacon, and Las Almas, each reckon their inhabitants at near 10,000. There are several silver mines, which, though beneficial to their proprietors, are worked to a very limited extent.

New Mexico.

New Mexico has been pompously dignified by Spanish writers with the title of a kingdom, though it does not contain more than 40,000 souls, on a few detached spots in a surface of near 6000 square leagues. It is a long and comparatively narrow strip of country, through which that great river Bravo del

Mexico. Norte runs. Its boundary towards the north has never been ascertained, though the government of the mother country has claimed, as a portion of the whole track, up to the 38th degree of north latitude. In this view of it, the length is 175 leagues, whilst its breadth varies from 30 to 50 leagues. Though it has been settled, as far as establishing some towns can be said to settle a country, for more than 200 years, yet it is separated by uninhabited and most malignant marshes, in which travellers are frequently exposed to attacks from ferocious tribes of unreclaimed Indians. Three stations were originally fixed on as garrisons *(presidios)* to maintain the communication; but in a general revolt of the Indians, they were either destroyed or abandoned. There are several passes which are dangerous for passengers, especially the defile of Robeledo, to the west of the great river, and the desert del Muerto, in both of which, many white persons have been massacred by the wandering Indians. The desert of the Muerto is a plain of 30 leagues in extent, and destitute of water, and the whole of that district suffers from the same cause, as there is not a single spring issuing from the mountains of *Los Mansos*. From this aridity alone, it is impossible that the two populations should ever unite, how much soever they may both increase their numbers. Though New Mexico is in the same latitude as Syria and Persia, the climate is remarkably cold. It sometimes freezes in the month of May, and a little to the north of Sante Fé, the great river is frozen, sufficiently hard to admit the passage of men and horses in the winter season. The mountains which bound this great river do not wholly lose their snow till the beginning of June. The elevation of the river in these cold regions has never been exactly ascertained; but, at the capital, it is not supposed to be greater than 2200 or 2600 feet. The most interesting circumstance attending New Mexico is the great river Bravo de Norte, the Mississippi of this part of North America, passing through the whole of it; a circumstance which, when the country is fully peopled, must make its possession a matter of the highest importance. This great stream has its origin in the Sierra Verde; the point of separation between those streams that run to the south sea, and those that run to the Mexican gulf. Like the Orinoco, the Mississippi, and other American rivers of similar long course, it has periodical rises and falls. The waters begin to swell in April, increase through May, and reach their highest pitch in June. In the drought of summer alone it is fordable, and then, from its rapidity, only by horses of extraordinary strength. The borders of it are well wooded, irregular, and highly picturesque. Its waters are remarkably turbid, like the Orinoco and the other vast rivers of South America. The recollection of a very extraordinary event, which occurred in this river in 1752, is preserved by the inhabitants. The whole bed of the river became suddenly dry for more than thirty leagues above and twenty leagues below El Passo. The water made for itself a new channel near the Porideo of San Eleazario. This loss of the river continued several weeks. The fine plains which surround El Passo, and which are irrigated by small canals, became wholly dry, and the inhabitants could only obtain water by digging wells in the forsaken channel of the river. After a time the stream resumed its former course, and continued its accustomed channels, probably because in the new course the deposit of its mud had filled the chasm, and the subterraneous conductors had become filled up. In some part of the northernmost division of New Mexico, the rivers empty themselves into the Mississippi, and the river De Pecos is probably the same with the Red River of the Natchitoches; and, perhaps, when the geography of the district is ascertained, the river called by the Spaniards Napestia, may prove to be the same as that which lower down is called by the Anglo-Americans the Arkansas. Mexico.

The colonists of New Mexico live in a state of perpetual hostility with the Indians that surround them; hence, though there are several towns and garrisons (*presidios*), there are no solitary farms or extensive plantations; all are concentrated around those places whose population is sufficient to bid defiance to the wandering Indians. The colonists are provided with all that nature absolutely requires from their own soil; the grains of Europe flourish, and the pastures supply abundance of animal food; all other supplies they must dispense with, as they are too far removed from the civilized world to maintain any commercial intercourse.

The capital is Santa Fé, situate to the east of the great river; its population is about 3600. Albuquerque, to the west of the Sierra Obscura, has a population of 6000, and Taos, to the north, has about 9000. The Passo del Norte is a garrison at which travellers must provide themselves with food to subsist on during their journey of 60 leagues over the desert which separates it from Santa Fé. The fields there are well cultivated with maize and wheat, and the vineyards produce excellent sweet wines. The gardens are well stocked with figs, peaches, apples, pears, and the other fruits of Europe. Artificial irrigation is here conducted on very simple but very good principles, and the effect is visible in all their crops.

California. Although the country of California is not, strictly speaking, a part of Mexico, yet it is a dependant upon the government of that viceroyalty, and can have no intercourse with Europe but through it; there seems, therefore, no place so proper to introduce the most recent information respecting it as after that country. It is divided into two intendancies, called New and Old California; the latter, though first settled, contains the fewest inhabitants; they are not estimated at more than 7000 or 8000, though the district contains nearly as many square leagues of surface. Of these, two-thirds are Indians, who, though they may be taught a few Catholic prayers and ceremonies, are almost as untamed as they were three centuries ago. The number of white people do not exceed 1000, who are dispersed on several missions and garrisons, designated on the Spanish maps with the names of towns, but which are in reality but miserable collections of hovels. Lorette is the most important place, being a presidio; and besides it there are two missions, Santa Ana and San Joseph; the latter of which has been best known from its having

Mexico. been the station in which the astronomical observations were made, and the transit of Venus observed in 1768, by the French Abbé Chappe and a Spanish astronomer, Don Vincente Doz.

New California, though to the north, and in a less genial climate, possesses a more fertile soil and more numerous population. The inhabitants were estimated at 15,000 in about 2000 square leagues of extent in the year 1802. The settlement of this country has been but recent, being first occupied by Spaniards in 1769. Its increase since that period, with very trifling additions from fresh emigrants, has been singularly rapid. The numbers in 1790 were 7748 souls, in 1800 13,468, and in 1802 15,562. The fertility of the soil is such, as must cause a continued increase, if, as cannot be doubted, the principle is correct that the multiplication of mankind is limited by the quantity of food that can be produced. It is stated, on good authority, that in the year 1791 there were sowed in the whole province 874 fanegas of wheat, the produce of which, at the harvest, amounted to 15,197, or more than 17 for 1. The next season recorded, that of 1802, was nearly as beneficial. The seed sown was 2089 fanegas, and the crop reaped was 33,576 fanegas. The increase of the flocks and herds seems to be keeping equal pace with the produce of the corn fields. In 1791, the black cattle were 24,958, and in 1802 they had been augmented to 67,782; whilst sheep, horses, mules, and pigs, had been similarly increased. As in other Spanish colonies, some impolitic regulations check its growth. The soldiers are discouraged from becoming cultivators, and the monks, who rule the country, rather discourage the settlement of white people, because they are less obedient than the Indians, whom they convert. In spite of these regulations, however, the colony bids fair to become populous and flourishing. The climate is remarkably salubrious, and the fruits of Europe flourish most luxuriantly, especially the vine, from which already some very good wine is made. There are abundance of wild animals, especially stags of vast size, with horns of enormous length, some said to be nine feet long. These animals, called venados, are remarkably swift of foot. They are caught by hunters on horseback, but being swifter than the best horses, they can only be come up to when they stop to drink, when a running noose is thrown over them, in the same dexterous manner in which the Spanish hunters take wild horses and cows. The Indians have a different mode of taking these animals. They place the horns of one on their own heads, and conceal in the bushes every thing but the horns which appear above; the herd approach without fear, and are then killed by arrows. The animals lately exhibited in London, under the name of Wapiti, were of this kind, and though stated by the proprietor to have been caught on the banks of the Missouri, were more probably the venados of California. They had not arrived at their full growth, but one of them was then on the shoulder seventeen hands two inches in height. The capital of New California is San Carlos de Monterey. It has an excellent bay, and good anchorage in six fathom water; and the English ships bound to the fur stations on the north-west coast of America, find refreshments there which are highly grateful in their protracted voyages. The other settlements on the coast amount to twelve, whose population varies from 500 to 1500 souls. The whole cultivation, and nearly all the inhabitants, are either in these places or in their immediate vicinity.

Recent History of Mexico. From the first conquest of Mexico by the Spaniards, to the invasion of Old Spain by the armies of Buonaparte, that country had continued to enjoy internal tranquillity, and had been free from the exercise and even the alarms of war. During the contests between Spain and England, its communication with the European metropolis had been interrupted, its commerce frequently intercepted, and small predatory bands of enemies had occasionally committed trifling depredations on its smaller maritime towns; but these events had little influence on the progressive improvement of the country, which had gone on increasing in wealth and population, with a rapidity unexampled in the communities either of the old or the new world.

If this state of tranquillity had rendered the practice of arms unnecessary, and removed from the inhabitants all tendency to acts of violence and bloodshed, it had not lessened those more vengeful feelings which seem innate in the human breast, and whose horrible exercise, when the passions became inflamed, is displayed in every form of implacable fury, wanton cruelty, and exterminating revenge.

As the events in Spain, which produced the bloody scenes that Mexico exhibited, are too well known to our readers to require any recital here, to connect the cause with the effect, we may proceed to the narration of the ferocious transactions which followed in Mexico the pretended cession of the Spanish dominions to the family of the occupier of the military throne of France.

The Viceroy of Mexico, at the period of the renunciation of Bayonne, was Don Josep Iturrigaray, a man nearly seventy years of age, undistinguished by any display of talent or energy of character. He was of mild and insinuating manners, and had been sent to Mexico by the influence of Godoy, to amass that fortune which most of his predecessors had made the principal object of their government. The details of administration there, as in all the other colonies, are vested in various *Boards* for the military, ecclesiastical, mining, fiscal, and judicial departments. The court of justice, called the *Royal Audiencia*, though it had no power to control the Viceroy, yet, from its important duties, of a mixed nature, was considered the highest tribunal, and was indeed a species of privy council. On the death or absence of the Viceroy, it exercised supreme power until his successor was appointed. As this is the most powerful body in each colony, care is taken that the majority of its members, called *oidores*, shall be natives of Old Spain, and as the emoluments of the office are very considerable, no small degree of influence, intrigue, and bribery, was usually exercised to obtain the appointment. The merchants of Vera Cruz, and of the city of Mexico, are an important body, and the principal members of it are erected into a board called the *Consulado*, which

had much influence and power, and considerable intercourse with the audiencia, and like that court consisted almost wholly of natives of Spain. Besides the boards already noticed, the municipal corporations, from their great possessions, had naturally a considerable share of influence; and that of the city of Mexico, containing a population of 140,000 inhabitants with immense estates, had a larger proportion than usually fell to the lot of other Spanish American cities. Those municipalities, called sometimes the *Cabildo*, sometimes the *Ayuntamiento*, and sometimes the *City*, were in their composition not unlike the ancient parliaments of France. Their members called *regidors*, their president, the *corregidor*, and their executive officers, the *syndics*, were chosen from the people, and originally by the people; but by a more recent practice, those offices had been openly sold by the crown, and the purchasers had the power of relinquishing them in favour of any of their own relatives. As the purchasers advanced in life, they most commonly transferred the office to a successor of their own family born within the colony, till, in process of time, the municipal corporations became composed of members, the far greater part of whom were natives of the country or Creoles. These cabildos, though not exempt from corruption, nor free from undue influence, and though subordinate to the audiencias, were by far the most independent bodies in Spanish America; and though they had little power except over their own revenues, they could and did remonstrate against any very grievous acts of oppression. The cabildo of the city of Mexico possessed a larger portion of the confidence of the people than any other public body, and sometimes assumed, from the popularity they enjoyed, a degree of authority in public proceedings, which it was doubtful, at least, if they were legally entitled to exercise by the laws, entitled "*la recopilacion de las Indias*."

Indistinct rumours only had reached Mexico of the tumults at Aranjuez, of the resignation of Charles the Fourth, the banishment of Godoy, and the proclamation of Ferdinand the Seventh (for the war with England intercepted regular correspondence), till, on the 15th of July 1808, a small vessel from Cadiz arrived with the French *Madrid Gazettes*, addressed to the Viceroy Iturrigaray. The Viceroy assembled the audiencia, and laid before them the intelligence these Gazettes contained of the transactions of Bayonne. By the advice of this body, he was induced to publish these French accounts, without any remarks, or intimation that any injustice had been done, or that any resistance was making, or would be made, to the new dynasty; but cool as the Viceroy appeared, and as the audiencia and the consulado really were on this occasion, the inhabitants of Mexico were thrown into a ferment of indignation; crowds eagerly assembled in the squares and public walks, and vengeance was denounced against France and its adherents, with all the characteristic fury of a Spanish populace.

The cabildo immediately presented an address tending to stimulate the loyalty and zeal of the Viceroy and the audiencia; they expressed in strong terms their adherence to the captive family, their detestation of Bonaparte and his tyranny, and their resolution to resist his dominion, by making the sacrifice of every thing dear to them in opposing him. They conclude, "This is the universal resolution of the kingdom, which Mexico, as its metropolis, displays to your excellency and to all the world; its inhabitants are resolved to maintain it with their persons and their property, and will shed the last drop of their blood in its support. In defence of this just cause even death itself will be cheering and delightful; as their career will then terminate with the noble satisfaction of being sons worthy of those fathers whose valour and loyalty they inherit. Mothers will themselves place in the hands of their sons the musket and the sword, that they may fill up the ranks in which their fathers have fallen; and should no other resource be finally left, they with moistened eyes will fire the towns and cities, and embracing their infants, rush with them into the flames, that the enemy may triumph over our ashes, but not over our freedom."

The whole viceroyalty of Mexico was in a state of alarm and confusion, which created a sprit of party, and gave birth to scenes of violence very different from the apathy and indolence which had prevailed for centuries preceding. The audiencia and consulado, all Spaniards looking to Spain for protection, and ultimately as a retirement when they had accumulated sufficient wealth, were afraid lest, if the French family were firmly established, which there was no reason to doubt, the Americans would withdraw all the ties which connected them with the peninsula. The municipality were in dread of being subjected to France, and, by that subjection, being deprived of their laws, and, above all, of their religion; of the excellency of which they affected to be themselves, and certainly made the Creoles, mulattoes, and Indians, deeply impressed. The audiencia and consulado urged on the Viceroy, with all their powers, the importance of following the fortune of Spain under every circumstance; whilst the municipality and the populace demanded a solemn abjuration of France and her partizans, and the immediate assembling of a junta composed of representatives of the different corporations of the kingdom, to assist and maintain the rights of the Spanish Bourbon family. Amidst this collision of parties, the Viceroy hesitated what part decidedly to take, though he gave, when acting without the influence of the audiencia, strong indications of adherence to the popular party.

After fourteen days of dissention, official advices were received that the whole of Spain had spontaneously risen to resist the cession of the crown, and that a body at Seville was appointed as the supreme junta of Spain and the Indies, and had proclaimed the captive Ferdinand king of all the dominions. Immediately on receiving this intelligence, without consulting the audiencia, Iturrigaray caused the young monarch to be proclaimed, and his name used, though without acknowledging, or even noticing, that the exercise of his power was vested in the junta of Seville.

The audiencia then urged submission to the assembly of Seville; the municipality urged the necessity

of collecting the representatives of the various corporations; and whilst these two bodies were busily employed in memorializing the viceroy, dispatches arrived from the junta of the Asturias assembled at Oviedo, claiming also supreme authority in the name of Ferdinand. This event furnished a strong ground to the Creoles for demanding a junta, and it was as eagerly resisted by the Spaniards, who feared that, if a popular assembly was once collected, such steps would be taken as must separate Mexico from Spain; if, as they expected, the French dynasty should ultimately be established in the peninsula. In this situation of affairs, because the viceroy declined acknowledging the authorities both of Seville and Oviedo, the members of the audiencia and the other European Spaniards, principally the traders, secretly organised a body of about 250 men, surrounded the palace in the middle of the night, seized Iturrigaray, his wife, and children, conveyed him under an escort to the Inquisition, and by day-break issued proclamations to quiet the populace, declaring him accused of heresy. A charge of this nature so shocked the feelings of a people deeply imbued with superstition, that, under their influence, no movements were made in the metropolis, and the body who had deposed the viceroy conveyed him to Vera Cruz, embarked him on board a ship, and sent him a prisoner to Cadiz. The audiencia, being thus in possession of supreme power, had the means of conveying to the junta of Seville such representations of their own conduct, and that of the viceroy, as best tended to exculpate themselves, and to keep the government of the country in their own hands. They knew that a charge of heresy, that the intention of degrading the image of the Virgin, however calculated to influence the mob of Mexico, would be treated with indignation, or at least with contempt, in Spain. The charge, therefore, transmitted to Europe against Iturrigaray, was of a nature to produce a greater influence on those who ruled in the peninsula. He was accused of designing to establish himself as an independent monarch, and of acting without the control of the junta of Seville. This accusation was effectual; on his arrival, the junta, delighted at having in their power one of those who had opposed their authority, or at least not acknowledged it, consigned him to a dungeon without investigation. He never was brought to any examination or trial; but, after three years' close confinement, when the Cortes published a general amnesty, he was released, ruined in his fortune, his reputation, and his health, and one among many proofs of the villanous injustice of the sovereign people of Spain.

The audiencia, in Mexico, having dethroned the viceroy, assumed the supreme authority, and placed at their head Garibay, an imbecile officer, more than eighty years of age, who was in every thing ruled by those who had appointed him. His authority was brief, however, as the junta of Seville sent orders for the archbishop to assume the vice-regal character. This ecclesiastic used great and effectual exertions to collect and send to the peninsula large quantities of treasure. His hatred to France, and his love to religion, especially to the Virgin of Guadaloupe, the tutelar saint of Mexico, made him a favourite with the Creole and Indian races; and, as he discovered no great acuteness in detecting the jobs, or the injustice of the audiencia, he was universally respected.

During these changes of government, however, the public not only in the capital, where the transactions had passed, but in the large cities of Guanaxuato, Guadalaxara, and Dolores, were agitated with alarms and suspicions; and their apprehensions were kept up by the municipalities, who certainly feared, that when Spain was overrun by the French, which they considered inevitable, the intrigues of the audiencia would deliver them over to Bonaparte.

When intelligence reached Mexico, that the central junta was dispersed, and that the French had possession of every part of Spain, except Cadiz, serious indications of insurrections became prevalent; but when it was announced, that a regency, installed by the fugitive junta, had deposed the archbishop, and nominated for his successor General Venegas, who was considered in Mexico as a traitor, who, by his conduct in the command of an army destined to co-operate with Lord Wellington, had rendered the victory of Talavera worse than a defeat, the dread of being delivered over by him to the dominion of France, so filled every mind in the whole kingdom of Mexico with alarm, as to produce an instant and spontaneous explosion. When Venegas reached the shores of his government, he was greeted with the intelligence, that the whole of the territory, whose command he came to assume, was in a state of revolt against the authority of those by whom he was appointed. The disposition to revolt had been much strengthened by the regency, who nominated Venegas, having expressed their approbation of the conduct of the party who had deposed Iturrigaray, and who, instead of censuring, had rewarded with decorations and appointments the individuals who had been most prominent in that transaction. This appeared to the Mexicans to be most decisive evidence of the design of the Regency and of their new Viceroy, to annex Mexico to the fate of Spain, when it should be totally subjected to the Corsican dynasty. The Spaniards had always impressed on the minds of the Americans the highest ideas of the powers of Spain, of the valour of her armies, and the talents of her officers; and this impression was so strong, that the disastrous occurrences of the war in the peninsula could only be accounted for by the Mexicans, on the supposition of treachery in those who affected to conduct the defence of their country.

When popular discontent is diffused through a country so extensively as it was spread in Mexico, a very slight event is often sufficient to rouse it into action. It is said, a plan for a general insurrection was laid, to take place on the 1st of November 1810, but that some events in the city of Dolores, about 50 leagues north-west of the capital, caused the explosion to take place prematurely in the middle of September. The Corregidor of that city, Don Manuel Dominguez, a native of America, was

suspected of being engaged in a plot against the government; and information of it having been communicated to the Audiencia of Mexico, he was suddenly arrested in the middle of the night; his colleagues in the municipality alarmed, and suspecting that they also should soon share the same fate, immediately resolved to commence a revolution.

The most considerable instigator of the revolt was Hidalgo, rector of Dolores, a town of 18,000 inhabitants, principally Indians. This man possessed great natural talents, and a degree of activity and exertion not common among the Creoles. He had distinguished himself in the University of Valladolid by his learning and abilities, and though a man of somewhat dissipated habits, had obtained a benefice, producing from 10,000 to 12,000 dollars a year. He had introduced various new branches of industry which had benefited the neighbourhood. He had established a manufacture of earthenware, a plantation of mulberries, on whose leaves silkworms were reared, and had introduced the various processes necessary for manufacturing the silk. He paid great attention to the education of his parishioners, and, by the appearance, perhaps the reality, of excessive devotion to the Virgin of Guadaloupe, he was looked up to by the inhabitants as a superior being. When Dominguez was arrested, this priest convoked his parishioners, and addressed them in language suited to their prejudices and their simple understandings. "This day," said he, "I ought to preach my first sermon on the duty of restitution to those we have injured (this is practised in a species of Lent, observed in September in Mexico); but, alas, this is the last sermon I shall ever deliver to you. I lament it, but there is no remedy! The Europeans give us over to the French. You see they have rewarded those who have deposed our Viceroy, they have displaced the good Archbishop who protected us, and have imprisoned the Corregidor, because he is a Creole. Farewell religion, you must become Jacobins! Farewell Ferdinand the Seventh, you must become Napoleonists!"—"No, father," shouted the Indians, "you must preserve us from this evil! The Virgin of Guadaloupe for ever! Ferdinand the Seventh for ever!"—"Well," replied he, "then the Virgin and Ferdinand for ever! and now follow your pastor, who has always watched for your happiness." The effect of this harangue was to rouse the natives, who followed the priest to the neighbouring towns, in all which, their numbers rapidly gathering, they collected more than 40,000 men. Three officers of the royal army, who had been fellow collegians with Hidalgo,—Allende, Aldama, and Abasolo, seduced the native regiments to which they belonged, and joined the insurgents.

These men began immediately to organise their force; Hidalgo was declared general in chief, Allende and Aldama lieutenant-generals; their standard was an image of the Virgin Mary, with the motto, *Life to religion, life to our most holy Mother of Guadaloupe, life to Ferdinand the Seventh, life to America, death to the wicked government.* A regiment of infantry from Telaya, and two squadrons of cavalry of the regiment De la Reyna, joined Hidalgo, who began his command by decreeing the abolition of the tribute paid by the Indians, and then led his forces to the north-west, towards the city of Guanaxuto, the capital of the mining district, where the great mass of silver was retained till it was convenient to transmit it to Perote, the principal fortress of the viceroyalty. The city of Guanaxuto and its vicinity contains a population of 80,000 souls; it is situated in a wild and mountainous country, and by its position might be defended by a small military force; but its inhabitants favoured the insurgents. The commander of the regular forces being killed in a first attack with some of his troops, the rest of the soldiers joined the cause of Hidalgo, and thus he took possession of the place, in which he found silver in coin and bars to the amount of more than 5,000,000 dollars. This important conquest was achieved within fourteen days after the commencement of the revolt, by a body numerous indeed, but ill armed, and worse disciplined, and, excepting the soldiers who had joined them, without any military appearance. Some few had fowling pieces, some few swords, many were armed with only knives at the ends of sticks, and some with the ancient Indian weapons, bows and arrows.

Hidalgo, in possession of Guanaxuto, assumed a kind of government there; he nominated officers for a military staff, ordered the bell-founders to cast cannon, established a mint, and coined money, and employed the most skilful mechanics and chemists to direct the working of the silver mines. He received a deputation from Valladolid, a city of 40,000 inhabitants, consisting of the chiefs of the ecclesiastical, civil, and military bodies of that city, who invited him to visit and organise that place, which he entered with considerable pomp and splendour, on the 20th of October. Here another regiment of the royal army, that of Pasquaro, joined the revolt. Plunder was forbidden, and good order was preserved, but to insure this, military execution was inflicted on fifteen of his Indians, who had been guilty of some disorders. From Valladolid Hidalgo determined to march to the capital, and fully expected to succeed in driving the Viceroy and the Spaniards from that city; on his march he was opposed by a small regular army under Truxillo, which, after a sanguinary contest, was defeated, and the remains of which fell back on Mexico to join the Viceroy.

Venegas, however, had taken measures to annoy the insurgents, in the points at which the insurrection commenced. Cadena was dispatched to Queretaro, about 50 leagues to the north-west, with one division, and Calleja to St Luis Potosi, about 100 leagues to the north, with another; by this plan the capital was unprotected, except by the defeated division of Truxillo, and the few Europeans who were hastily formed into volunteer corps. Hidalgo advanced, and appeared before the city; his columns were seen descending the mountains to the number of 70,000 men; but the Viceroy discovered considerable firmness, though he took the precaution to place the treasure and the stores in such a position as to in-

sure their secure transport to Vera Cruz. He relied, however, more on the thunder of the church than on his military powers; the inquisitor and the archbishop were prevailed on to pronounce a sentence of excommunication against the military priest. Hidalgo, about ten years before, had been the subject of a process before the holy tribunal, from which he had escaped, rather by connivance than by investigation. The process was revived, and sentence pronounced, by which he was cut off from the church in this world, and condemned to everlasting flames in the next. The Inquisition, in passing its sentences, is accustomed to increase the number of offences, with no more reason than in an English indictment, the prisoner is charged with "force and arms," with "being moved by the instigation of the devil," or with "not having the fear of God before his eyes;" and in the case of Hidalgo, he was accused of denying the existence of hell; and in another part of asserting, that a Pope who had been canonized was in hell. He was accused of adhering to the heresy of Luther, who maintained that the authority of scripture is superior to that of the Pope, and at the same time of denying the veracity of the *Bible*. These accusations and charges he turned into ridicule, in his answer, showed their opposition to each other, and added a profession of faith by no means deficient in orthodoxy. Though this ecclesiastical process had little or no influence on the forces of the insurgents, who had more confidence in Hidalgo's power to absolve, than in that of the Inquisition to excommunicate; yet on the inhabitants of the city, who were previously disposed to rise and join the insurgents, it had a powerful effect, and produced a resistance which saved it from capture.

Hidalgo, whose numerous troops, flushed with their recent victory over Truxillo, had invested the capital, was induced to desist from attempting to carry it by storm, either, as some assert, from a disinclination to the carnage that must have ensued, or, as others think, from his expecting to gain possession of it by negotiation: be this as it may, he delayed to act till intelligence reached him that the divisions under Cadena and Calleja had defeated some insurgent bands, had united their forces, and were marching to the relief of the capital. The chiefs of the insurgents became divided in their opinions of the next operations to be undertaken; and whilst the army under Calleja was advancing on the capital, Hidalgo and his associates trembling for the fate of the important city of Guanaxuto, determined to withdraw from Mexico, and taking a route to avoid the march of Calleja, retired north to secure the treasures in that place. This induced Calleja to change his route and pursue him. Guanaxuto, by nature a strong position, could only be attacked through a defile, to defend which, the insurgents had hastily constructed two batteries. These the troops of the Viceroy stormed, and entered the city, which was delivered to the vengeance of the enraged soldiers, who executed the most inhuman cruelties on all they met, without distinction of sex or age. The leaders of the insurrection, with the greater part of their military followers, escaped, and collected again at St Luis Potosi; whilst Calleja, with the utmost deliberation, executed the most sanguinary vengeance on those inhabitants of Guanaxuto who had aided, or even acquiesced in the rebellion.

Guadalaxara, one of the most populous cities of the viceroyalty, about 150 leagues north-west from the capital, had, in the mean time, raised the standard of revolt, and towards that part Hidalgo directed his march, strengthened by the addition of numerous bands, that joined him on his route, and encouraged by success in various skirmishes which occurred with small and scattered bodies of the royalists. He was received at Guadalaxara with open arms by the inhabitants; his stores were replenished, his troops recruited and refreshed, and some degree of discipline attempted to be introduced. From Guadalaxara an expedition was dispatched towards the important sea-port of St Blas, which succeeded in capturing it. The indefatigable Calleja, however, gave little respite to the insurgents, but with his handful of troops advanced towards them. Hidalgo having determined to risk a general engagement in defence of Guadalaxara, he posted his army on the banks of a river, on strong ground at the Bridge of Calderon. Calleja came up with him the 17th January 1811. The insurgents were well provided with artillery, some of heavy calibre, but ill appointed and badly worked; their cavalry were the most numerous part of their army, but in infantry they were very deficient. After various attacks which were at first resisted with firmness and success, Calleja succeeded in carrying all the batteries, and defeating the enemy, who abandoned their stores, ninety pieces of cannon, and their wounded, but retired in some degree of order, which the reduced state of Calleja's force could not enable him to prevent. Hidalgo retired on Zaccatecas, a city in the mining district, 125 leagues west-north-west from Mexico, containing 35,000 inhabitants. Here he made a short stay, cast some new cannon, coined money (with the head of Ferdinand), and again filled up his ranks, which the battle at the Bridge of Calderon had thinned. From hence he removed his head-quarters to St Luis Potosi, where one Villeria had collected an army of fresh insurgents. From this point small detachments of guerillas were equipped, which spread themselves over the whole table-land of Mexico, and kept the few partizans of the Viceroy in a state of perpetual alarm and activity. As the provinces to the north had shown a disposition to revolt, Hidalgo removed his head-quarters to Saltillo, a town at the entrance of the only pass through the range of high mountains, that is practicable for wheel carriages, in order to open a communication with Monterey, and from thence to Louisiana, a part of the United States from whence he hoped to obtain some stores and officers.

As the country of New Estremadura, New Leon, and New Santander, were in a state of insurrection, Hidalgo, and the officers of his staff, thought they might pass through with a small force, to organize, and not to conquer it. On the frontiers of these provinces, towards Fort Clayborne, in Louisiana, and to-

Mexico. wards the unreclaimed Indian nations, the Lipones and the Comanches, a few veteran companies were posted; these were privately concentrated, without the knowledge of Hidalgo, who, with his staff, artillery, and baggage, under a very weak escort, advanced towards St Antonio de Bejar, the capital of Texas. A force of 500 men had been sent forward from the Spanish army, and had passed Saltillo, where the main body of Hidalgo's army was quartered, without being noticed. One Ignacio Elizondo, a native of the country, who commanded a party of insurgents, was seduced, with a small body of men, to betray the excommunicated Hidalgo; and, by these three bodies, the whole of the staff, with Hidalgo, Allende, Aldama, the commanders, the artillery and the stores, were surrounded and captured. The officers, upwards of sixty in number, were immediately put to death, and the privates decimated. Thus perished Hidalgo, after a career of seven months, in which he had been the instrument of raising a power which he was unable to wield, but which became the cause of more bloodshed and desolation than even any civil war had before produced. Though deprived of its officers, its artillery, and its baggage, the insurgent army was neither defeated nor dispirited. The party of the Viceroy considered the destruction of all the leaders of the insurrection as the death-blow of their cause, and celebrated the event with much rejoicing; but the leaders appeared to be of little importance, for others, and with more ability, were instantly found to fill their places. Rayon, who had been formerly a lawyer, and had acted as secretary to Hidalgo, assumed the command of the army at Saltillo, which he found to amount to more than 40,000 men. With this force, avoiding an engagement with Calleja, he took post at Zaccatecas, from whence he attempted to open a negotiation that might terminate in a peace between the two parties, each of which claimed the merit of contending for the rights and authority of Ferdinand, and of the Catholic church. Rayon liberated three prisoners of distinguished rank, and commissioned them to propose to Calleja to desist from further hostilities, and to refer every matter in dispute to an assembly, to be immediately convened, of European and Creole Spaniards. To the proposal Calleja replied, " That, for the goodness of his intention, he had merited a pardon, which should be granted, if he would surrender himself and his army, but if he did not, he would march against him, chastise, and destroy him."

Whilst the insurrection began by Hidalgo, and continued by Rayon, was fluctuating with alternate successes and reverses, another, of an equally formidable nature, was supported on the coast of Mexico, bordering on the Pacific Ocean. Morelos, in early life, had served in the corps of royal artillery, and been promoted to the rank of serjeant; he had long left the army, and entered the church, in which he had attained the station of a parish priest, in one of the most populous districts in the neighbourhood of Acapulco. Here, as soon as Hidalgo commenced his operations, an insurrection also burst forth, of which Morelos was immediately declared the chief. He organized an army, which became formidable for Mexico. its discipline and numbers, and which successfully repelled the different bodies of Spaniards sent to attack him. At length the Viceroy collected an army, under the command of General Fuentes, to subdue these western rebels. Morelos advanced to offer battle, and an engagement took place at Tixtla, in which the insurgents were completely victorious, the royal army was dispersed, their cannon, stores, and even muskets, which, in their haste, the defeated threw away, became the prey of the victors. Morelos thus became master of the south-west of Mexico, captured the city of Acapulco, entered the province of Oaxaca, and gave orders which were obeyed even to Guatimala. His troops, instead of flying at the appearance of the royal army, resisted boldly its attacks, and at length became generally the assailants.

During this work of havoc, even in the provinces where the royalists had military possession of the towns, the open country was overrun by small bands of guerillas, who lived on the plunder of the country, and massacred, without regret, any Europeans that were unfortunate enough to fall in their way. The royal troops, on their part, wherever they passed, marked their track by thousands of Indians, who, without the formalities of trial, were hung on the trees that bordered the roads, or at the plantations by which they had marched. A mine situated at the entrance of Huasteca was worked by the insurgents, and furnished Morelos with silver, in a place, from the impenetrable nature of the country, secure from all fears of attack. Canas, a chief, occupied some mountains, from which he descended occasionally, and levied contributions, within five or six leagues of the capital; whilst, a little to the south, one Aldama troubled the bishoprick of Puebla, and intercepted the communication between Mexico and the post of Vera Cruz.

At this period the symptoms of insurrection in the city of Mexico became more alarming; the Creoles and Indians within its inclosure became insolent with every new success of the insurgents; and the delusive doctrines of the rights of man began to be propagated, and to annihilate their loyalty to Ferdinand, and their devotion to the Virgin of Guadaloupe.

We left two large organized armies, one under Rayon to the north, the other under Morelos to the south of the metropolis, and will briefly survey the progress of each. Rayon was at Zaccatecas, after the abortive attempt at conciliation, to which he appeared always anxiously to look, and to which he addressed several efforts. He was attacked by General Emperan, who commanded a part of the army of Calleja, and repelled him, with the total loss of his artillery, and the dispersion of his men. He then advanced to Zitaquaro, made it his head-quarters, and established a supreme executive council for Mexico, consisting of himself, the curate Verdusco, and the General Liceaga. The election was made by the acclamations of hordes of Creoles, Indians, and mulattoes, who were taught that in these acclamations they were exercising their newly acquired

sovereignty, and not made dupes of fanatical and intriguing leaders. Whilst exercising all the power of an arbitrary monarch in Zitaquaro, Rayon did not neglect the proper means of securing himself in his strong position, but fortified all the assailable points. The Viceroy concentrated his army to attack a place now the grand focus of the northern rebellion, and having collected a considerable force, he ordered Calleja to proceed against it: after overcoming several obstacles, the attack on the position succeeded, and Calleja obtained possession of Zitaquaro, with its powder-mills, the cannon foundery, and some stores; but Rayon, with his brother directors and the greater part of the army, retreated in safety to Zultepec, a still stronger position, about thirty leagues to the westward of Mexico, and from whence all the force of the Viceroy could not drive them, till the progress of their disorganizing principles had so far weakened all discipline, as to reduce them from an army into a banditti. Calleja, when in possession of Zitaquaro, exceeded the ferocity which he had before exhibited in different places from which he had driven the insurgents. The defenceless inhabitants were massacred by hundreds during the storming, and afterwards the whole property of each individual was confiscated; those who were permitted to live were banished for ever, and all the buildings of the place utterly destroyed.

When Rayon with his force was securely posted, in December 1811, in the strong position of Zultepec, dissentions began among the chiefs, which were the necessary result of the disorganizing principles they had infused into their ignorant and ferocious followers; all would be rulers, none would be ruled; and those men who had shown courage when opposed to their enemy, discovered equal hardihood in overturning all authority. In close connection with Morelos, who in the field displayed the talents of an able commander, Rayon rather became the civilian, and with his co-directors, issued proclamations and decrees, made solemn declarations of the sovereignty of the people, and attempted by wire-drawn distinctions, incomprehensible to his followers, to reconcile the sovereign authority with that of Ferdinand, whose name he still continued to use. At Zultepec he coined money, and established a printing press, from whence he issued a Gazette, entitled *Illustrador Nacional*, which was very rudely executed with wooden types cut for the purpose by a native Indian, and printed with indigo. The only military achievement of Rayon, beyond the occasional excursions made by his troops to levy contributions, was an attempt to take possession of the town of Toluca, which the royalists had fortified. He besieged it, but from the want of skill, and having neither heavy guns nor mortars, he failed in the attempt, and withdrew his forces to Tenango, where he was attacked, and though posted on strong ground, was compelled to retreat. In consequence of this reverse, he and the rest of the directory, with all the members of the government, were compelled to abandon Zultepec, and lead a vagrant life; wandering with the army through the northern districts, sometimes affecting to convene a national convention, at other times almost without food to keep together any considerable force: in fact, the contest had been carried on with so much fury, the scenes of the operations were so extensive, and the numbers collected in arms by the insurgents were so large, that the little cultivation which that rich soil requires was almost totally omitted, and famine contributed to add its share to the mass of suffering which the country endured.

In the beginning of the year 1812, considerable reinforcements of European troops had arrived from the peninsula, where the Cortes, though pressed on all sides by the French, contrived to spare some regiments, both from Gallicia and Andalusia, which were joined by a division formed in the island of Cuba. Venegas was superseded in the Viceroyship by General Calleja, who seems to have obtained the appointment by his own representations of the ferocious cruelty with which he treated the insurgents, which was more approved by the government at Cadiz, than the slight traces of humanity that Venegas had discovered.

Whilst these reinforcements were arriving and forming, Morelos was not idle, but discovered, considering the nature of his troops, and the deficiency in stores and ammunition, considerable military talents. We left him in possession of the south-west part of Mexico, and commanding the coast from Acapulco to Coasta-Rica. In that unhealthy country his men suffered from an epidemic fever, which induced him to advance to the high land; but he took an easterly direction, marching in two divisions, one towards Chantila, which he surprised, and the other towards Xalapa. He defeated the Spanish General Saavedra, entered the large mining city of Tasco, and occupied the whole mining district between the city of Mexico and Vera Cruz, and thereby prevented the capital from maintaining any connection with the sea. He continued to enjoy uninterrupted success for a long period; the town of Irucar was his principal depot, which resisted a regular siege, and repulsed the attacking army, whilst with his main body he almost surrounded the capital, and reduced it nearly to a state of famine. The newly arrived troops from Spain, who pompously denominated themselves "the conquerors of the conquerors of Austerlitz," were unable to withstand the rude attacks of these Creole bands, and were defeated in several battles, or rather large skirmishes; and, during the time they had passed in the vicinity of Vera Cruz, the dreadful fever of the country had considerably thinned their ranks. The communication between the capital and Vera Cruz entirely ceased in March 1812, and continued closed till the September following. Morelos took the city of Orizaba, in which he found money, tobacco of the king, and various stores, valued at more than 12,000,000 dollars. The disinclination to the service among the troops in the Spanish armies caused numerous desertions, and plans were formed, though, before the execution, they were detected, and the traitors put to death, for delivering up to the insurgents the castle of Perote, the strongest fortress in Mexico, where the treasure is collected; and the castle of St Juan

Mexico. de Ulloa, which commands the city of Vera Cruz. The city of Mexico was filled with rebels ready to rise and drive away the Viceroy, and was only kept in subjection by a rigid police, which filled every public building with suspected persons; forbade more than three men to converse together; and put to death some of the most respectable of those who were known to have favoured the insurgents. The defalcation in the revenue and the mint is a plain display of the distress to which the government was reduced. The *Alcavala* in the capital, a tax of six *per cent.* on all exchanges of property, usually produced 100,000 dollars monthly; its receipts were reduced to 8000, and the mint, which, before the disturbances, coined annually 27,000,000 dollars, in the year 1811 coined but 5,000,000, and in 1812 but 2,000,000; and, even for this purpose, the plate of all individuals was put in requisition by the Viceroy. Sanchez, a curate, acting under Morelos with five divisions of from 5000 to 6000 men, each occupied the whole of the plains of Puebla, the country of Tehuacan, and Orizaba, quite up to Xalapa. Calleja, with the only official royalist force, watched Morelos, whom he had contrived to separate from Rayon and Sanchez; and at last besieged him in Quautlan, which he had made his head-quarters, and in which his principal stores were collected. The town of Quautlan is situated on a rising ground, in the midst of a large plain, every part of which may be commanded from it. It is a large place, half a league in length, and a quarter in breadth, protected on one side by a rapid river, and on the others by strong walls, flanked by redoubts. The numerous party collected within the town soon produced famine, and an epidemic fever, which was more favourable to the besiegers than their cannon and bombs. The distress was great, and Morelos attempted to open, by a sally, a communication with a body of insurgents, who surrounded, and far out-numbered the besieging army; but the military skill and discipline of the troops under Calleja caused the sally to be unsuccessful; it was, therefore, necessary to abandon the place, and force a passage to their party. Morelos, in the middle of the night, formed a column, in the van of which were 1000 fusileers and 256 light horse, followed by 4000 lancers, then the carriages and light artillery, then the slingers and archers, and the rear-guard of infantry, with a regiment of cavalry. With this force he penetrated the lines of Calleja, and though with a tremendous sacrifice of the lives of his followers, extricated himself, his officers, and part of his troops, from the circle in which they were supposed to be securely inclosed, and in which he had sustained the attacks of a body of disciplined troops, supplied with cannon and other artillery, during seventy-five days, amidst privations and diseases, which had cost him half his army.

After disembarrassing himself from this perilous situation, Morelos filled up his vacant ranks, and in spite of an obstinate resistance, captured the town of Chilapa; here he offered to exchange his prisoners, which Calleja having refused, he put to death all the royalist officers and one-tenth of the privates in his power; hoping, as he expressed it, that this painful act of retaliation would put a stop to the inhuman practice which he charged his opponents with having commenced. He then entered Tehuacan, where he burned tobacco, belonging to the king, valued at 6,000,000 dollars. The Generals Sanchez and Montezuma (the latter a descendant of the kings of ancient Mexico, but a priest of a large township in the bishopric of Puebla, and distinguished by his virtues and talents) successfully attacked a division of the royalist army in St Augustine de Palmar, and succeeded in cutting off the whole; putting to death those few who surrendered, so that not a single individual of the garrison was left alive. A reinforcement of 1500 men landed at Vera Cruz from Europe; but after an ineffectual attempt to march into the country and join the royalists, they were shut up within the walls of that pestiferous city, and there, by scarcity of provisions and the black vomit, in less than six weeks their effective force was reduced to half their original number. In order to effect a junction with these troops, and to relieve the distress of Vera Cruz, the Viceroy drew together the forces which had been employed in the siege of Quautlan, and joining them with such others as he could collect, forced a passage by Cordova, and with 1800 mules loaded with flour, put a period to the famine, and returned to the high table-land with a reinforcement of 700 or 800 men only of those recently arrived from Spain.

Though the Viceroy had thus gained some additional force in men, and considerable supplies in stores, he was reduced to merely defensive operations, and could not hinder the insurgents from possessing themselves of any af those places in which they could collect treasure or stores, or destroy the king's tobacco, which, from the cessation of mining, had become the principal resource of the royal revenue.

After burning the tobacco of the three preceding harvests, which was stored in Orizaba, valued at 10,000,000 dollars, Morelos proceeded to Oaxaca, the district in which cochineal is produced. He attacked the capital Antiquera, and, after a sharp contest, entered that city, and acquired a considerable quantity of its peculiar production, as well as of other riches. By a very sensible letter which we have now before us, written from thence by a lady, the wife of a Spanish officer, who had escaped at the capture, it appears that Morelos was busily employed in drilling his army, inspecting their appointments, and providing them with stores; but he suffered no plunder, and permitted no cruelties; that he organized the courts of justice with all due formalities, preserved the greatest attention to all religious ceremonies; and though he put to death two Spanish officers of high rank, it was only in retaliation for two of his chiefs, Lopez and Armento, who had been executed in that city a short period before. He collected the remains of these men from the graves where they had been buried, and from the edifices on which they had been exposed, enclosed them in sumptuous coffins, made a grand procession to the Episcopal

 church, and interred them with all the most impressive rites of the Catholic religion.

The regular force, under the immediate command of Morelos, at this period amounted to 18,000 men; 10,000 of whom were regimented and clothed in uniform, and armed wholly with muskets, which, at different periods, had been taken from the royalist army. One of the royalist party, writing from Mexico in March 1813, adds, "Thus Morelos has secured a formidable army, after having been engaged in forty-six battles great and small, none of which he lost, and having, by his skilful retreat from Quautlan, demonstrated in the judgment of his opponent Calleja very superior talents."

During the whole of the year 1813, though considerable reinforcements to the royalist army arrived in Mexico, they were insufficient to enable Calleja to assume an offensive war, and though, on the other hand, a small force organized in the United States by Toledo, who had been a member for Mexico in the Cortes at Cadiz, invaded the northern provinces, they were defeated by the royalist General Arredondo, and the remnant effected their escape to New Orleans.

Morelos, in the latter end of 1813, made an attack on the city of Valladolid, in which he was repulsed, and being obliged to raise the siege, he retreated towards Puran; he was followed by the royalist army under the command of Llano, when a battle was fought, in which Morelos was defeated, and his second in command, Matamoros, with 700 men, were taken prisoners. Matamoros had a few days before taken 500 prisoners, and sent them for safety to Acapulco; these Morelos proposed to exchange for the prisoners taken at Puran, but Llano rejected the proposal, and put the whole to death; upon which Morelos ordered the 500 prisoners at Acapulco to be massacred, which was immediately executed. Such was the barbarity with which this furious and extended contest was carried on!

This defeat of Morelos gave a superiority to the royalists' cause, and fresh reinforcements having arrived, they were enabled to begin offensive operations, when the release of Ferdinand from captivity, and his return to his capital, was announced in Mexico. The leaders of the revolt calling themselves the national legislature, which had been driven from Zultepec, consisted only of Rayon, Liceaga, and Cos. These three men had exercised a species of mock government over the various bands; but having defended their conduct on the metaphysical principles of the French Convention, transmitted through the Cortes of Cadiz, they were, in conformity with those principles, compelled to call a congress, which met at Chilpansingo, and practised the same silly mimicry of decreeing abstract doctrines, as had marked the two European assemblies. Whilst debating on many whimsical subjects; whilst striving to conciliate their doctrine of the sovereignty of the people with that allegiance they still professed to Ferdinand,—the news of his release reached them. The more sober part were disposed to suspend their declaratory projects, and wait the result of the situation of affairs, which the establishment of the power to which they owed and professed subjection might produce; but the more violent, as is usually the case in such assemblies, overcame the more prudent; and instead of waiting calmly, or attempting to obtain a truce, they issued some arrogant and menacing proclamations, which seem to have precluded the possibility of negotiating, even if Calleja had been disposed to enter into them.

Calleja had been promoted to the government at Cadiz, on account of the severities he had practised and the zeal he had displayed. When the king was restored he was continued in the command, and as all the representations of the state of affairs in Mexico received by the monarchical government in Madrid came from him, they were tinged with that colouring which it was deemed necessary to give them, in order to justify the cruelties he had practised, and to induce Ferdinand to continue both the commander and the system, though they had hitherto produced only death and desolation. When a conciliatory proclamation of Ferdinand reached Mexico it produced a temporary pause, which, if Calleja had not been filled with ideas of vengeance, and the insurgents with the fatal whims of democracy, might have led to general tranquillity; but whilst the former only issued offers of pardon, to which the revolters could give no confidence, and to which, as appears by his own intercepted correspondence, none was due; the congress was busily employed in framing one of those ridiculous and impracticable plans, which, in the school of jacobinism, have been called *Constitutions*. It was founded on none of the customs or habits of the country, coincided with none of their prejudices, respected none of their institutions, and was only fitted to be the puppet of a day, and then to be neglected even by those who had framed it. Morelos, whose views were more practicable than those of the others, was too much occupied in the peculiar business of the military, to give a tone in the political disputes of the congress, otherwise he perhaps might have prevented some of the absurdities of which that body was guilty.

The new constitution renouncing allegiance to Ferdinand, and declaring Mexico an independent republic, was promulgated in October 1814; and, under this character of an independent state, privateers were fitted out, manned with the refuse of all nations, and encouraged, by a few secure asylums, to plunder, in the Gulf of Mexico and the Caribbean Sea, the peaceful ships of traders. Emissaries were sent to the United States to procure arms, ammunition, and officers. There Toledo, the member of Cortes, whom we have before noticed, succeeded in engaging General Humbert, who had formerly landed in Ireland, to join the Mexican army; they landed with some arms and ammunition, and proceeded in safety to a small fortress on the road between Vera Cruz and Xalapa, where, according to a preconcerted plan, Morelos was to have joined them; but the latter having been intercepted in his route, which he had undertaken with a small escort, was attacked by a body of royalists, his escort defeated, and himself made prisoner. Having thus fallen into the hands of the

Viceroy, he could expect no favour; he was accused before the Inquisition of heresy, but that tribunal refused to condemn him, or rather hesitated so long, according to its ordinary forms, that Calleja ordered him to military execution; yet such was the veneration in which he was held by all the inhabitants of the city of Mexico, that the government feared his execution there would produce some convulsion, and sent him secretly to an obscure village at six leagues distance, where he was shot in the back to indicate that he was a traitor.

With the death of this extraordinary man, every rational prospect of success to the insurgents was at an end. The democratic assembly convened under the fantastic constitution met at Tehuacan, and, as usual in such assemblies, spent its time in silly debates about the limits to be prescribed to the executive power, whilst they neglected to strengthen the armies, or to provide them with ammunition. After some time spent in personalities, an ape of Cromwell, or of Bonaparte, appeared in the person of Don Miguel Teran; he had been a partizan soldier, but at length became commander of the guards, the best disciplined corps in the service of the republic. This man, in December 1815, about one month after the death of Morelos, surrounded the hall of assembly with his guards, entered it with a detachment, expelled the members, and associating with himself two other persons, Alas and Cumplido, assumed the supreme power, and abolished the constitution. The irregular despotism, generated in democracy, was unequal to contend with the more consolidated despotism exercised by Calleja. Teran had hopes of assistance from the United States. Joseph Bonaparte, who had arrived there, was destitute of money, or unwilling to risk it in another royal speculation, and though he amused the insurgents with some hopes of assistance, and they flattered him with some prospect of being again a king, it terminated with the disappointment of the expectations of all the parties.

Calleja was strengthened by fresh troops, while the insurgents in numerous bands were scattered over the country, which they laid waste, but retreated as the royalists advanced. He thus describes them: "These bands are not sufficiently powerful to defeat the regular troops, to take towns, or to intercept the convoys; yet we have not strength enough to destroy them, but they are frequently defeated, often harassed, and always severely punished if they fall into our power."

During the whole time that Calleja ruled in Mexico, the predatory bands continued to commit depredations; a species of warfare more afflictive than any operations carried on in regular contests. The country became sick of the calamities it suffered, and the voice of conciliation was more wanted than reinforcements of troops. Milder councils at length prevailed in the cabinet of Madrid, and the execution of them was entrusted to the best hands in which they could be placed. Admiral Apodaca is too well known in the first circles in this country to require any eulogium; and as he went to Mexico, the herald of peace, he succeeded in lessening the irritation that prevailed, and reconciling the most respectable of the chiefs to his mild administration. Rayon, the most considerable, has accepted the terms that have been offered; and he and his whole army have laid down their arms, and taken the oath of allegiance to Ferdinand. We are unacquainted with the terms on which the conciliation has been effected; but as Rayon, during five years, contended with vigour, even after severe reverses against the royal troops; as his whole conduct, during the continuance of the contest, was marked by the most determined resolution, we may fairly conclude, either that the terms proposed were advantageous to his party, or that the expectation of success was so small, that further hope could not be entertained.

We need scarcely notice the expedition of Mina, who was equipped by some speculators in Europe for the conquest of Mexico. He was little acquainted with the dispositions of the inhabitants, and less with the nature of the country and the paucity of its resources. After effecting a landing to the north of Panuco, he penetrated into the country, where he was surrounded by the royalist troops, was taken prisoner with most of his followers, and at length received his death from the hands of the executioner.

From the execution of Mina, the tranquillity of Mexico was gradually returning, though occasionally interrupted by small assemblages of rioters rather than insurgents. They were dispersed, though not without the loss of some lives in the field, and of others on the scaffold.

The recent events in Spain, as far as certain intelligence has yet (20th September 1821) reached us, appear to have produced an effervescence in Mexico which has led to riotous assemblages in some parts of the viceroyalty of great, but perhaps of exaggerated extent. The communication between the capital and the coast has been occasionally interrupted, but never closed, when the Post was attended by an armed escort.

It is, however, too much to be feared, that a country in the circumstances of Mexico will continue to be the theatre of bloody contests as long, at least, as the metropolitan government in Europe shall remain in its present unsettled and revolutionary state.

See Humboldt's *Political Essay on New Spain*; translated into English. 4 vols. 8vo. Lond. 1811. —*Historia de la Revolucion de Neuve Espanã*, por Guerra. London, printed, but not published, 1812.—*El Español* (in 8 vols.), por Blanco White. London, from 1810 to 1815.——*Gazettas de Mexico*.—*Memoria* que el Doctor Don Miguel Ramos de Arispe, *present. a los Cortes de España sobre el estatado de su provincia* (in the periodical paper, *El Consico*). (w. w.)

Middlesex.

MIDDLESEX, an English county; and though in extent one of the least, yet, as containing within it the metropolis of the British empire, with its numerous population, its extensive wealth, and its repositories of art and science, and being the theatre of the most interesting historical and political transactions, naturally attracts to it the attention of all who are connected with the united kingdoms.

Boundaries and Extent.

This county is bounded on the north by Hertfordshire; on the west by Buckinghamshire; on the south by Surry, and at the eastern point by a small portion of Kent; and on the east by Essex. Its general figure is quadrangular, but rendered very irregular by the course of the rivers Thames, Coln, and Lea, which bound it on three sides, and by a considerable projection into Hertfordshire on the north. Its greatest length is twenty-three, and its greatest breadth seventeen miles. Its square contents are estimated at 285 miles, or 182,400 statute acres.

Population.

According to the census of the year 1811, the number of inhabitants was 953,276, of whom the males were 434,633, and the females 518,613. The number of families was 222,010; of whom 9,088 were employed in agriculture; 135,398 in trades and professions; and 77,524 were occupied in other pursuits. The marriages, in the year 1810, were 11,026. The baptisms of males were 11,859, of females 11,701. The burials of males were 11,370, and of females 11,026. The registers of baptisms and of burials are less certain criterions of their proportions to the population, than those of any other district in the united kingdom, from the greater comparative number of sectaries, whose births and deaths are unnoticed, especially births, in the parochial registers.

The population of the places, whose numbers exceed 2000, are as follow:

London (within the walls), -	55,184
London (without the walls), - -	65,425
London suburbs, exclusive of those villages marked thus *, which are also suburbal,	367,370
Westminster city, - -	162,085
Pancras, * with its hamlets, -	46,333
Bethnal Green, * - -	33,619
Chelsea, - - -	18,262
Hackney, with its hamlets, -	16,771
Islington. - -	15,065
Kensington, with its hamlets, * -	10,886
Mile-end Old Town, * - -	14,465
Shadwell, * - - -	9,855
Stepney parish, * including Poplar, Blackwall, Limehouse, Mile-end New Town, and Ratcliffe, - -	28,292
Fulham, with Hammersmith, -	13,296
Hampstead, - -	5,483
Ealing, including Old Brentford, -	5,361
Isleworth, including part of Hounslow,	4,661
Paddington, * - -	4,609
Tottenham, - -	4,571
Edmonton, - -	6,824
Enfield, - -	6,636
Chiswick, - -	3,892
Twickenham, - -	3,757
Bromley, * - -	3,581
Hornsey, with part of Highgate, -	3,349
Hampton, including the court and Hampton Wick, - -	2,754
Hendon, - -	2,589
Uxbridge, - -	2,411
Stratford le Bow, * - -	2,259
Hillingdon, - -	2,252
Heston, including part of Hounslow,	2,251
Stoke Newington, - -	2,149
Staines, - -	2,042

Face of the Country.

The face of this county may be described as a gentle sloping track rising from the banks of the Thames, its southern boundary, to the hills on the north, none of which rise more than 350 feet above the level of that river, and few even attain that height. In receding from the banks of the stream, the surface is gently undulated, with sufficient slope to secure the necessary drainage. The prospects in the southern division of the county, from the level nature of its surface, are not distinguished by extent or variety, and the eye is only relieved from the fatigue of uniformity, by the numerous buildings, plantations, gardens, and the rich verdure of productive grass fields. Even on the more hilly parts of the county the prospects are far less impressive than those on the opposite banks of the Thames, or than those which are to be seen on the borders of that river before it enters Middlesex. The best prospects of a rural kind are from the range of hills stretching from Pinner, Stanmore, Elstree, Totteridge, and Barnet, to the forest scenery of Enfield Chace. The Hill of Harrow, a projection from this ridge, is one of the highest points, and the whole of the richly cultivated valley of Middlesex is comprehended in the view from it.

Soil.

The original soil on the southern side of the county is of a most sterile kind of gravel; but the vast quantities of manure which have been furnished to it from the extensive cities in its vicinity, have been so spread on the surface, that a most luxuriantly productive soil of garden mould has been created, and from the same cause is renewed as rapidly as it becomes exhausted by the crops grown upon it. The northern part of the county generally consists of a soil of clayey loam, which, though rather difficult to plough, is, when properly pulverised, very well adapted for the cultivation of wheat, and has been long celebrated for the excellent quality of that grain which is produced upon it. The table of Queen Elizabeth was regularly furnished with white bread from the wheat grown in the vicinity of Hounslow.

Brick Earth.

In several parts of the county the loamy clay, converted by the addition of cinders, technically called breeze, into bricks, becomes the most profitable application of the soil. This is peculiarly the case where such soil is found in the immediate vicinity of the metropolis, or on the banks of the rivers or canals that communicate with it. "Round the one mile-stone on the Kingsland road," says Mr Middleton, "the surface is lowered from four to ten feet, by the earth having been dug up and manufactured into bricks, over an extent of more than 1000 acres; and it has been levelled, ploughed up, and laid down to grass. It is sufficiently dry, and by the help of town manure, is restored again to

Middlesex. excellent grass land; though it had previously yielded to the community, through the medium of the brick-makers, upwards of L.4000 *per* acre on an average of the whole level; but there are a few acres of choice marl earth, which have produced through the same medium L.20,000 *per* acre."

Agriculture. The greater portion of the land in the county is appropriated to the cultivation of grass, which is converted into hay for the supply of the numerous horses kept in the metropolis. These upland meadows have been gradually extending as the metropolis has increased, so that at present not more than 20,000 acres are under culture by the plough. The meadows, however, even those which have been longest laid down to herbage, discover the marks of their having been formerly ploughed. The great consumption of hay in the London markets has induced the most skill to be applied to that particular branch of rural economics which, under the term hay-making, is usually deemed the simplest of all agricultural operations, but is here managed in so superior a way as to bring to the stack hay of a quality far better than is preserved in the more distant counties. The corn grown in this county is inconsiderable; on an average of years, about 10,000 acres are sown with wheat, about 4000 with barley, about 3000 with beans, and about 2000 with pease; some rye is grown, but principally for green food, and scarcely any oats are cultivated. There are fewer sheep and cows kept in Middlesex than in any other county; but of the latter some thousands are maintained solely for the purpose of supplying milk for the daily consumption of the metropolis. Many pigs are fattened from the offal produced in the vast breweries and malt distilleries of London and its vicinity.

Horticulture. The horticulture of Middlesex, though it does not extend over quite so great a surface as its arable culture, produces a far greater annual return. Exclusive of the gardens attached to the houses of the nobility and gentry, the extent of land appropriated to the growth of fruit is reckoned by Mr Middleton to be 5000 acres, of that devoted to culinary vegetables 10,000, and of that used as nursery grounds and plantations 1500. The same writer estimated the annual value of the productions of horticulture at somewhat more than one million Sterling. The gardeners of Middlesex practise a wonderful economy in the raising of crops. The fruit gardeners have what they call an *upper* and an *under* crop growing on the same ground at the same time. First, the ground is stocked with apples, pears, cherries, plums, walnuts, &c. like a complete orchard, and called the *upper* crop. It is secondly fully planted with raspberries, gooseberries, currants, strawberries, and all such fruits, shrubs, and herbs, as are known to sustain the shade and drippings from the trees above them without the least injury: this they term the *under* crop. Some of these gardens have walls which are completely clothed with fruit trees, such as peaches, nectarines, apricots, plums, and various others, all adapted to the aspect of the wall. In order to increase the quantity of warmth and shelter in autumn, they raise earthen banks of about three feet high, laid to a slope of 45° to the sun. On these slopes they plant endive in the month of September; and near the bottoms of them they drill pease from October to Christmas: by this means the endive is preserved from rotting, and, as well as the pease, reach maturity at an early period. The common routine of the best kitchen gardeners is the following: Soon after Christmas, when the weather is open, they begin by sowing the borders, and then the quarters, with radishes, spinach, onions, and all the other seed crops. As soon afterwards as the season will permit, which is generally in February, the same ground is planted with cauliflowers, from the frames, as thick as if no other crop had then possession of the ground. The radishes, &c. are soon sent to market; and when the cauliflowers are so far advanced as to be earthed up, sugar loaf cabbages are planted from the before mentioned *seed* crops; and daily as these crops are sent to market, the same ground is cropped with celery for winter use. The foregoing rotation is the common practice, but there are many deviations according to the judgment of the cultivators, the state of the weather, and the demands of the market; but such a system can be pursued only in the vicinity of great cities, whose abundant manure gives the means of raising vegetable productions in defiance of the inclemency of our northern winters. A species of cultivation of a non-descript kind, partaking of the nature of agriculture and horticulture, is extensively pursued in this county. The ground is ploughed in January and February, and cropped with early pease, which are gathered green in June. The land is then sowed with turnips, which are sold in autumn, when the kind of cabbages called collards are planted, and these three crops are annually raised from the same soil.

Manufactures. The manufactories in the county of Middlesex are very numerous, and though, from the comparatively high prices of labour, rent, and fuel, few of the more coarse articles of consumption are made, yet the finer or more curious kinds of commodities are extensively produced in the vicinity of the metropolis. The manufacturers that employ the largest capitals are the brewers and malt distillers. The printing of calicos of the superior kinds. is conducted on a large scale at Isleworth, Staines, Old Ford, and some other places, but bearing no comparison in extent to similar establishments in the north of England and in Scotland. The silk manufactures, originally established by French Protestant refugees in the parish of Spitalfields, have been ever since continued; and though colonies from them have been transplanted to Coventry, to Staffordshire, Lancashire, and other parts of the kingdom, that branch of industry is the employment of nearly 40,000 persons. Ship-building and the various auxiliaries of that art, such as rope-making, sail-making, block and anchor-making, copper sheets and bolt-making, and numerous other appendages, are conducted on a very extensive scale. The other manufactures are so various, that it is scarcely possible to enumerate even the considerable ones. Of these the most prominent are watch-making, glass-blowing and cutting, dyeing, chemical preparations

Middlesex. for dyers and medical purposes, paper and pasteboards, gunpowder, china and earthenware, bricks and tiles, turnery ware, musical and mathematical instruments, cutlery, surgical and philosophical implements, gold and silver lace, gold and silver ornaments and utensils; and to these may be added carriages for luxury, and ornamental furniture for dwellings of every description.

Rivers. The rivers of Middlesex are the Thames, the Coln, the Brent, and the Lea. The former of these is navigable for barges, for almost its whole extent, to Leachlade in Gloucestershire, within a few miles of its source. The tide is felt as high as Teddington, above which the navigation is performed by penning the water at various locks till a sufficient body is collected, which, by making what is locally called a *flash*, permits the passage of the barges over the obstructions and shoals, which, a few hours after, become again impassable. The picturesque beauties on the banks of this stream are too well known to need a description in this place. The Coln is unnavigable. It enters Middlesex from Hertfordshire at the north-western extremity of the county, and falls into the Thames in various channels at considerable distances from each other, having in its course been applied to the working of numerous mills for paper, corn, and other purposes. The Brent, also unnavigable, enters the county from Hertfordshire, and joins the Thames at Brentford. The Lea is navigable for barges in its whole course through this county. It enters from Hertfordshire, forms the eastern boundary of Middlesex, and joins the Thames at Limehouse below London. Besides these natural streams the artificial one called the *New River* belongs to this county. The artificial channel in which this stream flows towards London has a very devious course, in order to keep the waters at a due level. It is ultimately received into a spacious reservoir near Islington, from whence, by means of pipes, its water is conveyed through the streets of the metropolis to the houses of individuals.

Canals. Among the public works of this county, the canals deserve notice. These are the Grand Junction, the Paddington, and the Regent's. The first forms a connection with the whole interior of the kingdom, and the second is connected with it. Through them, internal navigation is conducted to the manufacturing counties, and to the distant ports of Liverpool, Bristol, and Hull, and to the potteries, ironfounderies, and collieries of Staffordshire and Warwickshire. The Regent's Canal, recently completed, surrounds the whole of the northern side of the metropolis, around which it describes a semicircle, commencing at the dock of the Paddington Canal, and terminating at the river Thames at Limehouse. Its principal utility is supposed to be derived from forming the means of conveying coals and other heavy commodities from the river to the more distant parts of the capital without expensive land carriage.

Docks. The docks constructed, of late years, for the facilities of commerce, are most extensive and magnificent works, and the warehouses that surround them are wonderful exhibitions of the commercial opulence of this country, having been all completed from the capitals of individuals. The West India Docks contain about sixty acres of water, in which the largest vessels can float. The London, or Wapping Docks, are of nearly the same extent. The East India Docks are more than thirty acres, and near them is a dock belonging to private individuals (Messrs Wigram and Green) of nearly twenty acres, where the business of ship-building is carried on upon a scale that exceeds most of the establishments of the governments of Europe.

Public Edifices. The most remarkable edifices of this county are more properly described under the articles LONDON or WESTMINSTER in this work. Beyond the limits of those cities must be noticed the palaces of Hampton Court and Kensington; the Hospital of Chelsea for invalided soldiers; the Royal Military Asylum; the bridges of Staines, Vauxhall, and Waterloo; the archway under Highgate hill; Middlesex Hospital; St George's Hospital; Jews' Hospital; and Harrow School. The number of other erections, of a second and third order, are too numerous for recapitulation.

The changes of property have been so rapid in this county, and the taste for substituting fashionable novelty in the room of venerable antiquity has been so prevalent, that very few first rate seats are to be found, but a vast number of second and third rate houses, which, if removed from the vicinity of the metropolis, would attract considerable notice. The most remarkable residences are Bently Priory, Marquis of Abercorn; Brandenburg House, Margrave of Anspach; Bushy Park, Duke of Clarence; Caenwood, Earl of Mansfield; Chiswick House, Duke of Devonshire; Fulham Palace, Bishop of London; Holland House, Lord Holland; Littleton, Thomas Wood, Esq.; Osterley House, Earl of Jersey; Sion House, Duke of Northumberland; Strawberry Hill, Countess of Waldegrave; Wrotham Park, George Byng, Esq.; Cannons, Sir Thomas Plummer; Bush Hill Park, William Mellish, Esq.; Harrow, Lord Northwick; Sion Hill, Duke of Marlborough.

See Middleton's *View of the Agriculture of Middlesex*; and Brayley's *Beauties of England and Wales*. (W. W.)

MINERALOGY.

MINERALOGY is that department of Natural History which makes us acquainted with all the properties and relations of minerals. It is divided into two grand branches, viz. Mineralogy, properly so called, and Geology. Mineralogy treats of the properties and relations of *Simple Minerals;* while Geology considers the various properties and relations of the *Earth, Atmosphere,* the *Waters of the Globe,* and the *Mountain Rocks,* or those mineral masses of which the crust of the earth is principally composed, and which are generally of a compound nature.

I. MINERALOGY.

1. *System of Arrangement.*

The arrangement of simple minerals has always been a subject of controversy with mineralogists; and the discussions to which it has given rise have materially contributed to the advancement of our knowledge of the natural and chemical history of minerals. Many, as Berzelius and others, contend for the Chemical arrangement, according to which the species are grouped in conformity with their chemical composition and characters; others, as Werner, Hoffman, &c. reject the pure chemical, and adopt the Mixed Method, in which the species are arranged and determined according to the conjoined external and chemical characters; and of late years the Natural History plan, or the arrangement according to external characters alone, has been advocated by Mohs, Jameson, &c. We are inclined to recommend the latter; and of all the natural history arrangements, we consider that of Professor Mohs as the most philosophical, and we have accordingly adopted it in the present article.

2. *Characters of Minerals.*

As the characters employed in the natural history system of mineralogy are principally those named external, we shall here confine our attention to these, referring for an account of the others to the article MINERALOGY, already published in the *Encyclopædia Britannica.* We shall first give an account of the characters used in the construction of the different principal divisions of the system; and next enumerate and define those characters which are employed in the *description* of the species, subspecies, kinds, and varieties of simple minerals.

I. CHARACTERS EMPLOYED IN THE DETERMINATION OF THE CLASSES, ORDERS, GENERA, AND SPECIES.

I. Regular Form.—II. Cleavage.—III. Hardness. IV. Specific Gravity.*

I. REGULAR FORM.

1. *Simple and Compound Forms.*

The first step Crystallography takes in the consideration of the regular forms occurring in the mineral kingdom, is to distinguish them into *simple* and *compound* ones. A simple form is contained under *homologous* planes, or such as are equal, similar, and equally disposed in respect to each other; a compound one is contained under planes, *not homologous,* or such as are not equal, similar, and equally disposed to each other.

2. *Combinations.*

A compound form is termed a *combination.* The combinations consist of the simple forms, and each face occurring in them, belongs to a particular simple form, in as far as it is not homologous with others.

3. *Edges of Combination.*

The edges, in which the faces of different forms meet or intersect each other, are called *edges of combination.* The denomination of the edges between the homologous faces depends upon the simple forms themselves, or upon their peculiar situation, and their other qualities.

4. *Development of the Combinations.*

An object of the greatest importance for crystallography is the illustration of the *development* of the combinations. A combination is developed by showing of what simple forms it consists, and in what relations those simple forms are to each other. The manner in which this is done is as follows: First, the connection existing among certain simple forms is exhibited; and these simple forms are arranged accordingly into series, the members of which, between certain limits, follow constant laws, and are known in all their geometrical relations, if it is possible to determine their distance from a known member, or to assign them their relative position in a series, which contains the same member. The position of a member in the series is determined by considering the situation of the edges of combination; and the development of the latter will, therefore, depend upon two points; first, to make out the kind of the simple forms they contain; and then, from the observed situation of the edges of combination, to determine to which member of the afore-mentioned series they belong, or which places they occupy in this series.

5. *Preparation for the Development of the Combinations.*

Let fig. 1, Plate XCVIII., be a combination of two

* Certain varieties of *colour,* the *lustre,* and also the *streak,* are occasionally used in forming the characters of the systematic divisions.

Mineralogy. rhomboids. The faces ADEED, ADE′E′D,...belong to one, the faces DEE″E″E′,...to the other. Let the edges of combination DE,DE′,...be parallel, and the faces of the two forms that meet in them equally inclined to each other. The plane angles at the apex, or at the solid angle formed by three equal plane angles of the former, are smaller than the same of the latter; and likewise the inclination of the *terminal edges*, or at those which terminate in the apex, or in the terminal point of the axis AX of the former, is smaller than the same of the latter, which, therefore, is called the *more obtuse*, whilst the former bears the denomination of the *more acute rhomboid*. It would not be sufficiently intelligible to derive the relation which exists between the two rhomboids, from the figure in its present state, the absolute dimensions remaining unaltered. Let, therefore, the axis of the more obtuse rhomboid increase, till it equals that of the more acute one, without any alteration in the angles, and consequently in the parallelism of the edges of combination depending upon them. Whilst the axis increases, that part of the faces of the more obtuse rhomboid, which is visible in the combination, will become narrower and narrower, till it disappears, when the length of the axis is equal in both the forms. The planes of the more obtuse rhomboid are in this case tangent to the terminal edges of the more acute one, and the absolute dimensions are now in that state, in which they allow of a clear development of the relations between the forms which the combination contains.

6. *Upright Position and Horizontal Projection.*

Place a rhomboid in such a position that its axis is vertical. This is called the *upright position*. From the six angles of the rhomboid, B′,C′..., fig. 2. which are no apices, draw perpendicular lines B′O′, C′R′...to a horizontal plane, and join the points in which these perpendiculars meet with the plane, by straight lines O′R′, R′Z′...The regular hexagon H′O′R′Z′N′T′ produced by those lines is called the *horizontal projection* of the rhomboid.

7. *Relation of the Two Rhomboids expressed by the Side of the Horizontal Projection.*

By comparing the planes of the horizontal projections HORZNT and H′O′R′Z′N′T′ belonging to the rhomboids, we find that, the axes being supposed equal, the horizontal projection of the more obtuse is four times as large as that of the more acute, or it is to the same in the ratio of 4 : 1. From this follows the ratio of their sides = 2 : 1. Therefore, two rhomboids, the horizontal projections of which are in the ratio of 4 : 1, or the sides of these in that of 2 : 1, the axes being supposed equal, will be able to produce a combination in which the edges of combination are parallel to each other; also to the terminal edges of the more acute, and to the inclined diagonals (those which join the apex with the opposite angle of the faces) of the more obtuse rhomboids; provided the absolute dimensions allow the space to be limited by both the forms at the same time. This is one of the relations between simple forms, which are useful and necessary for explaining the combinations, and of which the other relation will be explained in the following paragraphs. Mineralogy.

8. *Fundamental Form, Derivation, Derived Form.*

What has been said above leads to a general method, one form being given or chosen, to find one or several others, which are in such relations to it, as to be fit for explaining the combinations. The form chosen for this purpose is called the *fundamental form* or *type*; the proceeding by which the other forms are produced the *derivation*, and those forms themselves the *derived forms*.

9. *Relation of the Two Rhomboids expressed by the Axis.*

The easiest method of expressing the relation of the derived rhomboids to the fundamental form (§ 7) is not that by the sides of the horizontal projections, the axes being supposed equal. Let, therefore, the derived rhomboid, without any alteration in its angles, diminish in size (as could be done by sections parallel to its faces) till its horizontal projection becomes equal to the horizontal projection of the fundamental form; its axis will decrease to half of its former length. Now, the horizontal projections being supposed equal, the axis of the derived rhomboid will be to the axis of the fundamental form in the ratio of $\frac{1}{2} : 1 = 1 : 2$, an expression of the relation between the two forms, which, on account of its easy application, we shall retain and make use of as we proceed.

10. *Inversion of the Proceeding.*

The mode of proceeding, by which the more obtuse rhomboid has been derived from the more acute one, can easily be inverted; setting out from the more obtuse one, we can, by the same way, in an opposite direction, derive the more acute rhomboid. The diagonals being drawn upon the faces of the rhomboid, and by planes laid through three and three of them, those parts which are situated on their outside being taken away, what remains will be a rhomboid more acute than the fundamental form. The axes of both these forms are equal, whilst the sides of the horizontal projections in the fundamental and the derived rhomboid are in the ratio of $1 : \frac{1}{2}$. Now, the horizontal projections being equal, the ratio of the axes will be $= 1 : 2$.

11. *Generality of the Relations.—Series.*

These modes of proceeding, and the relations between the derived forms, are general. If, therefore, from one rhomboid, taken for the fundamental form, another more obtuse has been derived, this same more obtuse rhomboid, considered as a fundamental form, will yield another still more obtuse; and if, on the other hand, from the fundamental form a more acute rhomboid has been derived, the same proceeding applied to the resultant form will give another still more acute; and this may be continued on either side *ad infinitum*. The ratio between the axes of any two subsequent rhomboids, the horizontal projections being supposed equal, has everywhere the same exponent. The axes are therefore in a geometrical progression, and the rhomboids repre-

Mineralogy. sented by these axes are themselves said to form such a progression or a *series*.

12. *Laws of Progression of the Series.*

Let A be the fundamental form, its axis $=a$. Let B represent the first, C the second more obtuse; B′ the first, C′ the second more acute rhomboid, the rhomboids will follow each other thus:

$$\ldots \text{C, B, A, B}', \text{C}' \ldots$$

their axes will be

$$a, 2a, 4a$$

or they are in the ratios of

$$\tfrac{1}{4}, \tfrac{1}{2}, 1, 2, 4 \ldots$$

$$\ldots 2^{-2}, 2^{-1}, 2^0, 2^1, 2^2 \ldots$$

equal to those of the powers of the number 2.

The more obtuse rhomboids B, C . . . and the more acute ones, B′, C′ . . . derived from a given or supposed fundamental form A, their horizontal projections being equal, produce a series, in which the axes of the subsequent members increase on one side, and decrease on the other, like the powers of the number 2.

13. *Designation.*

The method of designating crystallizations, whether simple or compound, is founded on the present and similar series, to be developed afterwards. Represent the fundamental form by any arbitrary letter, in this case, according to the practice hitherto observed, by R. The sign of any other member of the series contains the same letter; the exponent of the fundamental number of the series, which, in the present case, is the number 2, being added for the sake of expressing the place occupied in the series by the number to be designated. This yields the crystallographic sign for one member, and by applying the same proceeding to the others, the designation also of the whole series.

14. *Continuation.*

The above mentioned part of the series of rhomboids is

$$\text{C, B, A, B}', \text{C}';$$

the ratio of their axes

$$2^{-2}, 2^{-1}, 2^0, 2^1, 2^2;$$

its designation, therefore,

$$\text{R}-2, \text{R}-1, \text{R}, \text{R}+1, \text{R}+2,$$

and in the same way $\text{R}+n$, the general term for each member of the series, which may be transformed into a particular one, by putting whole numbers, positive or negative, instead of n in the expression.

15. *Usefulness of the Designation.*

From the ratio of the axis to the side of the horizontal projection being known in a rhomboid, all the rest of its ratios, its dimensions (plain and solid angled), &c. can be deduced. The side of the horizontal projection is supposed equal in all the members of the series, and made $=1$ in the calculations which refer to the rhomboid. The designation contains therefore, by representing the relation of the axes, every thing required as a basis of calculation; and since it does not require any figures (for instance those of a fundamental form), the letter R signifying by itself a rhomboid, the designation is also evident, and upon this depends the easiness of its application in crystallography. Mineralogy.

16. *Limits of the Series.*

There can be no doubt of n being able to obtain any possible value; or, which is the same, the series may be continued as far as we choose. This produces always new rhomboids, as long as n has a finite value. On one side the axes will increase, if n increase and remain positive; on the other the axes will decrease, if the negative value of n increases. Let n become infinite, the axis will likewise be infinite; let $-n$ become infinite, the axis will be infinitely small. It is clear that the limits of the series will be, on one side, a rhomboid of an infinitely large axis, on the other a rhomboid of an infinitely small axis, and their several signs must therefore be $\text{R}+\infty$ and $\text{R}-\infty$; so that

$$\text{R}-\infty \ldots \text{R}+n \ldots \text{R}+\infty$$

represent the series between its limits.

17. *The Limits are Regular Six-sided Prisms.*

It is very easily shown that a rhomboid of an infinite axis is a regular six-sided prism; for at the same time, as the axis increases, the six faces of the rhomboid approach nearer and nearer to parallelism with the axis, and they become really parallel with it, if the axis becomes infinitely long. For rendering more evident in what manner the regular six-sided prism is the limit of the series of rhomboids, we can imagine each face of the rhomboid to make a revolution round an immoveable line QS, fig. 3. This line is the side of that regular hexagon, which can be inscribed into the horizontal projection HORZNT; the hexagon itself will be the basis or transverse section of the prism, and it differs from the horizontal projection by both its contents and its situation. If the axis of the rhomboid decrease till it ultimately evanesce, the faces contiguous not only to one, but also those contiguous to the other apex, concide in one plane; and the rhomboid is changed into a plane figure, equal and similar to the horizontal projection, to which it is parallel, and appears, therefore, in all the combinations as a face perpendicular to the axis. It must here be remarked, that forms of infinite dimensions cannot be produced by themselves, or as simple forms, but appear only in combinations.

18. *Position.*

The series of rhomboids, already described, contains every thing concerning the dimensions and the ratios of its members, as far as each of them is considered singly or by itself. But there is still one object of great importance to be noticed, if those members are considered connected together, or in combinations. This is their *position*. It is evident that two subsequent members of the series, as, for instance, R and $\text{R}+1$, or, in general terms, $\text{R}+n$ and $\text{R}+n+1$, will produce the above combination

in which the edges of combination are parallel, not only with each other, but also with the terminal edges of the more acute, and with the inclined diagonals of the more obtuse rhomboids; but they will produce this combination only in the case of their being in such a position, that the terminal edges of the one are in the same plane with the inclined diagonals of the other, which plane passes at the same time through the axis, as is shown by fig. 2, Plate XCVIII. This position of two rhomboids is termed the *turned position*, because it arises when a rhomboid is turned out of its former position, under an angle of 60° or 180°. If a rhomboid, in the turned position, undergo a new revolution of 60° or 180°, it returns to that which it occupied before, and this is called the *parallel position*. Rhomboids that affect a parallel position with each other, have their terminal edges and their inclined diagonals distributed in such a manner, that the terminal edges of both, on one side, and the inclined diagonals of both, on the other, fall into one and the same plane, passing through the axis.

19. *Position of the Members in respect to each other.*

The position of the fundamental form R is considered as the *normal position*, to which those of the derived members are referred. In reference to R, R+1 and R—1 will be in a turned, R+2 and R—2 in a parallel, R+3 and R—3 in a turned position again, and so on; from which it follows, that any two subsequent, or, in general, any two members of the series, between which an even number of members (0 in the above case being considered as even) are wanting, will be in the turned position, whilst any two members of the series, between which an odd number of members are wanting, will affect the parallel position. All those members, therefore, which have their exponent an even number, are in the parallel, those which have their exponent an odd number, in the turned position, if compared with R, the fundamental form of the series. The position exercises no influence upon the regular six-sided prism, since, by turning it under angles of 60° and 180°, its faces will come into their former situation.

20. *Scalene Six-sided Pyramids.*

The rhomboid allows several forms to be derived from it, which are not themselves rhomboids like the original. Lengthen the axis of a rhomboid, fig. 4, Plate XCVIII, on both sides to an indefinite but equal distance, and from the angles B, C, ... draw straight lines to the terminal points A′, X′, of the lengthened axis. The planes which can be laid through any two contiguous lines of these, and the lateral edges, BC, CB, ... of the rhomboid will produce a form, which, from its faces being scalene triangles, is called a *scalene six-sided pyramid*. The solid angles, A′, X′, at the terminal points of the axis, are its *apices*; the edges which terminate in these apices are the *terminal*, and those which correspond with the lateral edges of the rhomboid are the *rhomboidal edges* of the pyramid. The terminal edges allow of a farther distinction into *more obtuse* and *more acute* ones; the faces being on AB, the first, inclined under a greater, on AC the other, under a less angle.

21. *Their Axis a Multiple of the Axis of the Fundamental Form.*

Instead of lengthening the axis, we may conceive it to be multiplied by a certain number, expressed in general by *m*. The values of *m* must be determined by observation, or, which is the same, they must be derived from combinations containing six-sided pyramids. They cannot, therefore, be fixed arbitrarily, if we expect them to be confirmed by observation.

22. *Series of Scalene Six-sided Pyramids.*

From each rhomboid, several scalene six-sided pyramids may be derived, and we are authorized to expect as many forms of this kind as observation has discovered different values for *m*. By deriving scalene six-sided pyramids, according to a constant *m*, from the subsequent members of the series of rhomboids, a *series of such pyramids* is produced, the axes of which partake of the law followed by those of the series of rhomboids. For the horizontal projections of the pyramids are identical with those of the rhomboids, because the rhomboidal edges of the pyramids have the same situation as the lateral edges of the rhomboids from which they are derived; and the axes of the pyramids, being equal to the axes of the rhomboids, multiplied by a constant number *m*, will therefore persist in the ratio of those.

23. *Designation.*

The letter P, in general, signifies a pyramid, but more particularly a six-sided pyramid, if referred to a form derivable from the rhomboid. The quality of a scalene six-sided pyramid, in which there occur differences according to the relation of its axis to that of the rhomboid, must be made evident by the designation. Include the general sign for the pyramid, expressed in such a manner as to refer to the rhomboid from which it is derived, within crotchets ( ), and add the number of derivation, or that by which the axis of the rhomboid has been multiplied, in order to produce the axis of the pyramid, in the form of an exponent; the result will be the crystallographic sign of a scalene six-sided pyramid. Thus $(P+1)^3$ represents a scalene six-sided pyramid derived from R+1 by multiplying its axis by the number 3; and $(P+n)^m$ is the general term of any or of each series of scalene six-sided pyramids, which can be derived from a series of rhomboids having R for its fundamental form, according to the value of *m*, determined for each particular series. If the axis of the rhomboid from which a scalene six-sided pyramid is derived, and the number of derivation *m* are known, the dimensions of the pyramid are easily to be found; thus every thing that has been said above (§ 15.) in respect to the designation, can be equally applied in the present case.

24. *Values of m.*

Although the value of *m* be, as far as experience goes, most commonly = 2, 3, or 5, yet it sometimes affects others, and even fractionary numbers. The only thing to be said in general of the value of *m* is, that it must be greater than 1, rational and positive.

25. *Limits.*

Every series leads to its limits; it is, therefore, to be expected, that the series of scalene six-sided pyramids will have limits of their own. It appears by an easy geometrical construction, that scalene six-sided pyramids, derived according to a constant *m*, from the different members of a series of rhomboids, or even from any rhomboid though it be no member of that series, if cut perpendicularly upon, and through the centre of their axes; that such pyramids will have a common, or equal and similar transverse section, provided only the horizontal projections of these rhomboids have been equal. This section is an equilateral dodecagon of alternately equal angles. The limits of a series of scalene six-sided pyramids must therefore be a scalene six-sided pyramid of an infinite axis; which, since *m* cannot become infinite, must be deriveable from a rhomboid of an infinite axis, that is to say, from a regular six-sided prism. The limit will, therefore, appear in the shape of an *unequiangular twelve-sided* prism, of the same transverse section, which the finite members of the series produce. Each series of scalene six-sided pyramids is limited by a prism of this kind; the number of different prisms will therefore be equal to the values of *m*, upon which the angles of their transverse sections depend. The opposite limit, viz. the scalene six-sided pyramid of an infinitely small axis again appears in a plane figure, equal and similar to the horizontal projection, its faces being perpendicular to the axis of those forms with which it is combined. The general sign of an unequiangular twelve-sided prism is $(\mathrm{P}+\infty)^m$. The face perpendicular to the axis does not require any particular designation, since that of $\mathrm{R}-\infty$ (§ 15) is already applied to it. Respecting the position, both of the scalene six-sided pyramids, and of their limits, the unequiangular twelve-sided prisms to each other, and to the rhomboidal form from which they are derived; §§ 18 and 19 contain the necessary explanations.

26. *Subordinate Series of Rhomboids.*

There are several rhomboids in connection with R, without being members of the series derived from it, because their axes, the horizontal projections being equal, are not products of the axis of R, multiplied by powers of the number 2. These rhomboids follow, however, the law (§ 12) which governs the series of rhomboids immediately derived from R, and their axes are results of the axes of the members of this series multiplied by a certain coefficient. Series arising in this way are termed *subordinate series*, whilst that which has been derived from R has the relative name of the *principal series*.

27. *Coefficients of the Subordinate Series, and how the Members of these belong to each other and to the Members of the Principal Series.*

Members of the subordinate series are geometrically obtained by laying planes into the homologous terminal edges of the scalene six-sided pyramids derived from the members of the principal series, and by enlarging these planes till they inclose the space by themselves. By applying the planes to the more obtuse terminal edges, the resulting coefficient is $=\frac{3m+1}{4}$; by applying them to the more acute ones, it follows $=\frac{3m-1}{}$ If the three most common values of *m* are one after the other put into the expressions, each of the two coefficients give rise to members of two different subordinate series; but at the same time it yields one member of the principal series, namely, if $3m\pm1$ becomes equal to a power of the number 2. These numbers of the principal series are not, however, objects of the present consideration. The subordinate series, whose coefficient contains, besides a power of the number 2, the number 5, is styled the *first*; that whose coefficient, also besides a power of the number 2, contains the number 7, the *second* subordinate series. The members of the subordinate series arrange themselves with those of the principal series in such a manner, that the axes of those which are put together stand in the ratio of $1:\frac{5}{4}:\frac{7}{4}$. According to this disposition, a rhomboid, whose axis contains five-fourths of the axis of $\mathrm{R}+n$, or which is $=\frac{5}{4}\cdot2^n a$, its horizontal projection being equal to that of R, is $\mathrm{R}+n$ of the first subordinate series, and its designation $\frac{5}{4}\mathrm{R}+n$, a rhomboid whose axis is $=\frac{7}{4}\cdot2^n a$, is $\mathrm{R}+n$ of the second subordinate series, and its designation is $\frac{7}{4}\mathrm{R}+n$. Any other value of *m* affords other subordinate series. The members of a subordinate series cannot be interpolated, or put between those of the principal one, without undoing both these series themselves. The limits of the subordinate series are identical with those of the principal series; the position of their members follows from their derivation.

28. *Isosceles Six-sided Pyramids.*

Apply pairs of planes to the terminal edges AC, of a rhomboid, fig. 5, Plate XCVIII., in such a manner and inclination, that those from the upper apex, AHO and AOR, may intersect those from the under apex, XHO and XOR, in a plane figure HORZNT, similar to and parallel with the horizontal projection. The result will be an *isosceles six-sided pyramid.* The axes of both the pyramid and the rhomboid being equal, as appears from the derivation, the sides of their horizontal projections are in the ratio of 3 : 2. Hence the horizontal projections being supposed equal, the ratio between the axis of the pyramid and that of the rhomboid will follow $=2:3$, or the first will contain $\frac{2}{3}$ of the axis of that rhomboid from which it is derived. The isosceles six-sided pyramid, derived from $\mathrm{R}+n$, is designated only by $\mathrm{P}+n$ (§ 23), on account of its being always obtained by a similar proceeding from its rhomboid.

29. *Series of Isosceles Six-sided Pyramids.*

Each member of the principal series of rhomboids has its concomitant isosceles six-sided pyramid of the ratio just stated, the horizontal projections being equal. This gives rise to a series of isosceles six-sided pyramids, the axes of which, their horizon-

tal projections being equal, increase and decrease as the powers of the number 2; that is to say, they follow the general law of all those forms which are derived from the rhomboid.

30. *Limits and Position.*

The limits of this series are regular six-sided prisms of infinite axes, like those of the series of rhomboids. Let the axis of an isosceles six-sided pyramid increase, whilst the horizontal projection remains unchanged, the inclination of the faces at the edges of the basis (those in which the faces from different apices meet) will likewise increase till it becomes $=180°$, in which case the axis will be infinite. In this case, each two corresponding faces from the different apices coincide into a single plane parallel with the axis, and the isosceles six-sided pyramid is thus transformed into a regular six-sided prism, the basis or transverse section of which is the horizontal projection itself. By this basis and its situation the present prism differs from that (§ 17), which limits the series of rhomboids; and by this the necessity of considering them as two distinct forms becomes evident. The crystallographic sign for the limit of the series of isosceles six-sided pyramids is $P+\infty$. The opposite limit, merely a face perpendicular to the axis of any of the foregoing forms, requires no particular designation. Since the faces of an isosceles six-sided pyramid, when this is turned round under 60° or 180°, resume their former situation, there is no difference prevailing in the position of the members and limits of this series, either in respect to themselves, or to the other forms derived from the rhomboid.

31. *Derivation from the Isosceles Four-sided Pyramid.*

Consider an *isosceles four sided pyramid* (Plate XCVIII. fig. 6), a form contained under eight equal and similar isosceles triangles, as a fundamental form; place it in its upright position, by making its axis AX vertical, and apply to it the process § 5. The tangent planes will limit a space representing again an isosceles four-sided pyramid, the plane angles of which at the apex, and the inclination of the faces at the terminal edges, will be greater than the same in the fundamental form, and hence it will likewise be the more obtuse of both.

32. *Ratio of the Derived Pyramid to the Fundamental Form.*

The axes of these pyramids are equal to each other. The horizontal projection of the more obtuse is that square which can be circumscribed to the horizontal projection of the fundamental form; and, accordingly, its content twice the content of the horizontal projection of the fundamental form, the ratio of their sides $=\sqrt{2}:1$. Suppose now the horizontal projections of the two pyramids to be equal, the axis of the derived more obtuse pyramid will be to the axis of the fundamental form in the ratio of $\frac{1}{\sqrt{2}}:1$.

33. *Inversion of the Proceeding.*

This proceeding can be applied inversely, in order to obtain from the fundamental form the same more acute four-sided pyramid, from which, by the proceeding applied directly, the fundamental form would have been the result. This inverse application is as follows: Draw in the faces of the fundamental form perpendicular lines from the apices to the edges at the basis, lay cutting planes through every two contiguous of these lines, and separate those parts of the pyramids which lie outside of them. The remainder, inclosed by the cutting planes, will be again an isosceles four-sided pyramid, having the same axis as the fundamental form, but a horizontal projection, whose content is half the content of the horizontal projection of the fundamental form, and the ratio of their sides, therefore, $=\sqrt{\tfrac{1}{2}}:1$. The horizontal projections being made equal, the axis of the derived more acute pyramid is to the axis of the fundamental form in the ratio of $\sqrt{2}:1$, which is the inverse of the ratio deduced above.

34. *Series and Designation.*

By continuing the derivation, the more obtuse pyramid produces another still more obtuse; the more acute another still more acute, and thus arises a series of isosceles four-sided pyramids, whose axes, their horizontal projections being equal, increase and decrease as the powers of the square root of 2; which law of progression can be expressed by $2^{\frac{n}{2}}$, or $\sqrt{2}^{n}$. The designation of this series is concordant with the principles already laid down and followed (§ 13). The fundamental form receives the letter P. Hence its neighbouring members will be

$$\ldots\ P-2,\ P-1,\ P,\ P+1,\ P+2,\ \ldots$$

their axes, that of P being $=a$,

$$\ldots\ \frac{a}{2},\quad \frac{a}{\sqrt{a}},\quad a,\quad a\sqrt{a},\quad 2a;\ \ldots$$

their ratio to each other,

$$\ldots \sqrt{2}^{-2}+ : \sqrt{2}^{-1} : \sqrt{2}^{0} : \sqrt{2}^{1} : \sqrt{2}^{2}; \ldots$$

and $P+n$ the general term of the series, which, by the substitution of any whole positive or negative number in the place of n, gives a certain determined member. The present designation is quite the same as that in § 28, and as another to be mentioned in § 44. However, the observation in page 431 is sufficient to show the impossibility of any confusion or ambiguity that could arise from making use of identical signs for the expression of different forms.

35. *Limits.*

If n becomes greater or smaller than any given number, a transformation takes place similar to that by which the isosceles six-sided pyramid gave rise to the regular six-sided prism: the series of isosceles four-sided pyramids terminates on one side in an unlimited four-sided prism, on the other in a plane figure, equal, similar, and parallel to the horizontal projection, and these two forms represent the limits of the series. In respect to the first, however, there

occurs the particular circumstance, that the series is doubly limited; because the different members in their succession assume a different position. The derivation shows the pyramids, P—1 and P+1, to stand in such a position towards P, that the sides of their bases are parallel with the diagonals of the basis of P; whilst, in P—2 and P+2, the sides and the diagonals are parallel with the same lines in the basis of the fundamental form. The former are said to be in a *diagonal*, the latter in a *parallel* position with P; and every thing contained in § 18 and § 19, in respect to position, may be applied here, if only, instead of 60° and 180°, a revolution of 45° is imagined. Suppose now the two different prisms, the regular six-sided, as well as the rectangular four-sided, in both their peculiar positions. The faces of the first will, after having been duly turned, assume their former situation, which is not the case in the second; and hence it becomes necessary to adopt two rectangular four-sided prisms of an infinite axis as limits of the series of isosceles four-sided pyramids, one being in a parallel, the other in a diagonal position with P. The sign of the first is $P+\infty$, that of the second $[P+\infty]$. The opposite limit, where there is no difference in the position, is represented by $P-\infty$; and the whole series of isosceles four-sided pyramids between its limits appears thus,

$$P-8 \qquad . P+n \ldots \begin{Bmatrix} P+\infty \\ [P+\infty] \end{Bmatrix}$$

36. *Scalene Eight-sided Pyramids.*

With the isosceles four-sided pyramids there are connected *scalene eight-sided pyramids*, contained under sixteen equal and similar scalene triangles (Plate XCVIII. fig. 7). These eight-sided pyramids depend upon the four-sided by the same process of derivation, by which the scalene six-sided pyramids take their rise from the rhomboid. The application of this process to the isosceles four-sided pyramid supposes, however, a preparation of this form, which is effected by enlarging its faces beyond the edges at its basis, and by drawing in these enlargements triangles, equal and similar to the faces of the pyramid. Thus, the points $a, a' \ldots x, x \ldots$ are fixed in two squares that are perpendicular to the axis AX, in its terminal points, or in the apices of the pyramids. Now, produce the axis of the pyramid on both sides to an indefinite but equal length, or multiply it by a number m, greater than 1 positive and rational (§ 24). Join, then, the upper terminal point A′ of the lengthened axis with the points $a, a' \ldots$ in the under, the under terminal point X′ with the points $x, x' \ldots$ in the upper square, by straight lines. The points SS′.., in which these lines intersect each other, will lie in the prolongation of the basis of the four-sided pyramid. We now join these points with the neighbouring angles of the base by straight lines, the result of which will represent the basis of the derived scalene eight-sided pyramid, which may now be completed without difficulty. The most common, though not the only values given for m by nature, are 3, 4, and 5.

37. *Series of Scalene Eight-sided Pyramids.*

If the number of derivation m be constant, the resultant scalene eight-sided pyramids have similar bases, the axes of the isosceles four-sided pyramids may be whatever they will The application of the described proceeding to the subsequent members of the series of isosceles four-sided pyramids will, therefore, m remaining for all the members the same, not only produce a series of scalene eight-sided pyramids, subject to the law followed by the isosceles four-sided pyramids, which is that of $\sqrt{2}$; but the bases or transverse sections of all the members of this series will be similar to each other. The designation of an indeterminate nth member of such a series is $(P+n)^m$, and it is evident, that as many values of m as experience gives, so many different series of scalene eight-sided pyramids will arise.

38. *Limits.*

The limits of those series are, on one side unlimited unequiangular eight-sided prisms, the transverse sections of them being similar to the bases of the members of the series; on the other side a plane figure, which in the combinations appears as a face perpendicular to the axis. This is evident from what has been said above, and there remains only to be added, that the prisms of an infinite axis, coming into consideration in two different positions, they must be taken for two different forms, or as double limits of the series. These two positions are the *parallel* and the *diagonal*, as in § 35; the parallel being that which prevails between scalene eight-sided pyramids and that isosceles four-sided from which they are derived; whilst forms of this kind in the diagonal position are supposed to have undergone a horizontal revolution of 45°. Now the eight-sided prisms may be considered as scalene eight-sided pyramids, derived from isosceles four-sided pyramids of an infinite axis, namely, the rectangular four-sided prism, according to a certain value of m. The necessity of considering the four-sided prism in m two different positions (§ 35) must therefore be extended to the eight-sided. The designation of the series of eight-sided pyramids, between their limits, will accordingly be thus:

$$P-\circ \qquad (P+n)^n \qquad \begin{Bmatrix} (P+\infty)^m \\ [(P+\ )^m] \end{Bmatrix}$$

39. *Subordinate Series.*

There are series of isosceles four-sided pyramids, belonging to that of § 33, which, in reference to the latter, or the *principal series*, are termed *subordinate series*. The members of these series are obtained by placing tangent planes in the homologous terminal edges of the scalene eight-sided pyramids; the same proceeding which applied to the scalene six-sided pyramids produced the subordinate series of rhomboids. The coefficient for the more obtuse terminal edge (if $m 7 1+\sqrt{2}$) is $= \frac{m+1}{2}$; that for the more acute one (under the same supposition) $= \frac{m}{\sqrt{2}}$. If m be determined, each of those coefficients gives a mem-

Mineralogy. ber of a particular series. The members of the principal and of the two subordinate series arising from $m = 3, 4,$ and 5, arrange themselves thus: $1 : \frac{3}{2\sqrt{2}} : \frac{5}{4}$; and are said to belong together in this order. An isosceles four-sided pyramid, therefore, whose axis, the horizontal projection being equal to that of P, is $= \frac{3}{2\sqrt{2}} . \sqrt{2}^n a$ represents the member P$+n$ of the first subordinate series, and bears the designation of $\frac{3}{2\sqrt{2}}$ P$+n$; and a similar pyramid, the other circumstances remaining the same, with an axis $= \frac{5}{4} . \sqrt{2}^n a$ is the member P$+n$ of the second subordinate series, expressed by the designation $\frac{5}{4}$ P$+n$. The limits of the present series coincide with those of the principal series. The positions of its members in respect to each other, and to the members of the principal series, will become evident, by comparing what has been stated of their derivation with § 27. regarding the position of the subordinate series of rhomboids.

40. *Scalene Four-sided Pyramids.*

If in the basis of an isosceles four-sided pyramid, the diagonals are supposed unequal, the pyramid itself is transformed into a *scalene four-sided pyramid*, or into one whose basis is a *rhomb*, its faces *scalene* triangles, and its terminal edges of a different magnitude, the one more obtuse the other more acute, as is represented by ABOBCX, fig. 8. From this we may conjecture that several of the preceding methods of derivation, though with some modifications, will also in this case be applicable.

41. *Derivations from it. Auxiliary Form.*

Apply to the *homologous* terminal edges of a scalene four-sided pyramid tangent planes, and enlarge them till they intersect each other in every possible direction; the result will be no form limited on every side, or such as is finite in all its dimensions. If the tangent planes are laid in *all* the terminal edges of the fundamental form, a form limited from every side will indeed appear, but this form is *not* a *simple* one, its faces being homologous only by four and four (§ 1). The form thus arising represents a four-sided pyramid, with an *oblong rectangular* basis, AFGHIX, fig. 8; and most of the crystallographers consider it as such, and term it accordingly. In this place it must be considered only as an *auxiliary* or *intermediate* form, which is not the derived form itself, but useful and auxiliary for its derivation.

42. *Derived Form.*

Suppose tangent planes to be laid in the terminal edges of the *auxiliary form*, in such an inclination that those from the upper apex produce by their intersection with those from the under apex a rhomb similar and parallel to the basis of the fundamental form, and situated in the prolongation of this basis. Mineralogy. The result will be a scalene four-sided pyramid, the basis of which is similar to that of the fundamental form; but the plane angles at the apex, and the inclination at the terminal edges, being greater than in this form, the derived will be more obtuse than the fundamental form.

43. *Ratio to the Fundamental Form.*

The two pyramids, as produced by the derivation, have the same axis, the ratio between the basis of the derived, and the basis of the fundamental pyramid being that of 4 : 1. This ratio is evident, since the basis of the auxiliary form is double of the basis of the fundamental form, and that of the derived form again double of the basis of the auxiliary form. Hence the horizontal projection of the two forms being supposed equal, the ratio between the axes of the derived and of the fundamental pyramid is that of $\frac{1}{2}$: 1. The process of derivation, by which the more obtuse pyramid is produced, is liable to an inversion like that in § 10.

44. *Series. Designation. Limits. Position.*

From a continued derivation on both sides of the fundamental form, a series of scalene four-sided pyramids, of equal and similar bases, will evidently arise, the axes of which increase on one side and decrease on the other, like the powers of the number 2. P$+n$ will be the sign of an indeterminate nth member of the series, and if n becomes infinite, the series reaches its limits, which are on one side an obliquangular four-sided prism, whose transverse section on the other side is a horizontal plane, whose figure is equal and similar to the horizontal projection of the fundamental form. The designation of the series between its limits becomes thus:

$$P-\infty \ldots P+n \ldots P+\infty.$$

It must be remarked, that such differences on account of the position of the members of the series as are met with in the rhomboid (§ 18) and the isosceles four-sided pyramid (§ 35), are not to be found in the scalene four-sided pyramid.

45. *Further Derivations.*

The members of the present series are, or this series itself is, now the foundation of several other derivations; and although the forms derived by them will be nothing but scalene four-sided pyramids and obliquangular four-sided prisms, yet the variety in the relations of those forms is great enough to surpass that of the forms in connection with the rhomboid, and with the isosceles four-sided pyramid, for which reason it is one of the most interesting objects of crystallography. The derivations already mentioned apply as well to the fundamental form itself as to the auxiliary form; and they are similar to that which has been employed in deriving the scalene eight-sided from the isosceles four-sided pyramid.

46. *From the Fundamental Form.*

Instead of the isosceles (§ 37), suppose the scalene

four-sided pyramid to be the fundamental form, and prepare it for derivation by enlarging its planes beyond the edges at the basis, and by drawing triangles equal and similar to the faces of the pyramid in these enlargements. The points $a, a' \ldots x\, x' \ldots$ will no longer be the angles of squares, but of oblong rectangles, the planes of which are perpendicular to the axis AX in its terminal points. Produce now the axis of the scalene four-sided pyramid on both sides to an indefinite, but equal length, or, what comes to the same, multiply it by a number m, enjoying the general properties mentioned, §§ 24, 26. Draw straight lines from the points $a, a' \ldots$ in the lower rectangle to the upper apex A′, from the points $x, x' \ldots$ in the upper rectangle to the under apex X′ of the lengthened axis, and join their intersections $s, s' \ldots$ in the plane of the enlarged basis by straight lines with the angles of this basis. The resultant octagon will not have alternately equal angles, like that in § 36, which is the basis of the scalene eight-sided pyramids, but it will be irregular, fig. 9, since of the angles B, B′, c, c', only the opposite are equal to each other. A form constructed upon such a basis cannot be contained under equal and similar planes, or it cannot be a simple form. Like the four-sided pyramid of an oblong rectangular basis, it is considered as an auxiliary or intermediate form, whose resolution gives the simple forms of which it consists.

47. *Resolution of the Auxiliary Form.*

This resolution is executed by enlarging those places which are equal and similar to each other, till the rest disappear. In the present case, the resolution produces two different scalene four-sided pyramids of equal axes, their bases being different amongst themselves, as well as from the bases of the fundamental form. They are termed *scalene four-sided pyramids of dissimilar bases, derived from the fundamental form,* and more particularly that in which the long diagonal of the fundamental form remains unaltered, the *pyramid belonging to the long:* that in which the short diagonal remains unaltered, the *pyramid belonging to the short diagonal of the fundamental form.*

48. *Designation.*

This important difference between the two forms must be expressed by the designation. The designation $(P+n)^m$ used for the scalene eight-sided pyramids in § 37, if referred to forms in connexion with the scalene four-sided pyramids, denotes at the same time both of the pyramids just mentioned. In order to make it applicable to each of them singly, it is now necessary to express their difference in respect to the diagonals of the fundamental forms, which is effected by adding the signs ˘ and ¯. Thus $(\breve{P}+n)^m$ represents a scalene four-sided pyramid of dissimilar basis, derived from $P+n$ according to the number m, which belongs to the long diagonal; $(\bar{P}+n)^m$, another pyramid of the same properties which belongs to the short diagonal of P.

49. *Ratios.*

The pyramids just mentioned differ from the members of the series (§ 44), 1*st*, in their axes, which, the axis of P being $=a$, are expressed by $2^n ma$; 2d, by the ratio of the diagonals of their bases. Let in P the ratio of the axis to the long and to the short diagonal be that of $a:b:c$, or the ratios of the same lines in $P+n$ that of $2^n a:b:c$; the ratio of the homologous lines will be

$$\text{in } (\breve{P}+n)^m = 2^n ma:b:mc,$$
$$\text{in } (\bar{P}+n)^m = 2^n ma:mb:c,$$

as follows easily from the consideration of a few triangles in the figures required for explaining the derivation. Hence the ratio between the diagonals of the bases in the derived forms, that of the fundamental form remaining constant, depends only upon the number m. Accordingly, if m be supposed constant, all the pyramids of this kind, derived from scalene four-sided pyramids of similar bases, will likewise, as far as they belong to one or the other diagonal, contain similar bases or tranverse sections, the axes of the forms, subservient to the derivation, may be whatever they will.

50. *Double Series.*

If those forms are the members of the above series, each m gives rise to *two series* of derived pyramids of a dissimilar basis, viz. one whose members refer to the long, and another whose members refer to the short diagonal of the basis of the fundamental form. From each of those series having constant transverse sections in all their members, it appears that the obliquangular four-sided prisms, limiting them, must likewise be subject to the equality of transverse sections or bases. Both the series stand, therefore, between their limits, thus:

$$P-\infty \ldots (\breve{P}+n)^m \ldots (\breve{P}+\infty)^m$$
$$P-\infty \ldots (\bar{P}+n)^m \ldots (P+\infty)^m$$

What has been observed in § 44 in respect to position, may be equally applied here. The values of m hitherto most commonly, though not exclusively observed, are $= 3, 4, 5$. But neither in this case are they the only ones.

51. *Derivations from the Auxiliary Form,* § 41. *Ratios of the Series.*

Instead of the fundamental form P, or of $P+n$, suppose the auxiliary or intermediate form, belonging to it, to take its place; by applying to it the proceeding described in §§ 46, 47, the form produced is a compound one like that in § 46, but its resolution yields again two simple forms, which are also *scalene four-sided pyramids, whose bases are dissimilar to those of the fundamental form.* These pyramids can be distinguished from each other by referring, the one to the long, the other to the short diagonal; from those derived in § 47, by the form to which the derivation is applied, since, in § 47, it is the fundamental form itself, in the present case, the auxiliary form belonging to it; which latter circumstance is expressed in the crystallographic sign by the letter

Mineralogy. r added to P. From the dimensions of the three lines disposed perpendicularly to each other in the pyramid $P+n$, the axis and boththe diagonals, being in the ratio of $2^n a : b : c$, it will follow, the ratio of the homologous lines in the scalene four-sided pyramids of dissimilar basis, derived from the auxiliary form, which belongs to the long diagonal of the fundamental form, or in

$$(\breve{P}r+n)^m \text{ to be} = \left(\frac{m+1}{2}\right).2^n a : \quad b \quad : \left(\frac{m+1}{m-1}\right)c,$$

$$\text{in } (\bar{P}r+n)^m \qquad : \left(\frac{m+1}{2}\right).2^n a : \left(\frac{m+1}{m-1}\right)b :$$

The dependence of the ratios between the diagonals of the basis, only from m, is evident; and this remains unaltered, how much soever a and n may be allowed to vary. If the derivation is applied to the whole series in § 44, there will arise two series of scalene four-sided pyramids, which proceed according to the law of the fundamental series, and are limited by obliquangular four-sided prisms, partaking of the similarity in the transverse sections of all the members. The crystallographic designation of the series, between their limits, stands thus:

$$P-\infty \ldots (\breve{P}r+n)^m \ldots (\breve{P}r+\infty)^m$$
$$P-\infty \ldots (\bar{P}r+n)^m \ldots (\bar{P}r+\infty)^m$$

The values of m are here the same as in the above mentioned cases. To the position applies what has been said in § 44.

52. *Subordinate Series.*

That there are certain *subordinate* series belonging to the series § 44, which, in reference to the former, may also be considered as the principal series, can easily be supposed from the agreement existing between the forms derived from the scalene and those derived from the isosceles four-sided pyramid. In order to obtain the members of these subordinate series, enlarge the faces of the fundamental form, fig. 10, Plate XCVIII., on both sides; draw in the enlarged faces triangles, equal and similar to the faces of the fundamental form; through the point $a, a' \ldots x, x' \ldots$, thus determined, lay rhombs, similar and parallel to the basis of the fundamental form; multiply the axis by a number m; join the points X′, A′, of the lengthened axis by straight lines with the said points $a, a' \ldots x, x'$; and, lastly, reduce the derived pyramid which has a basis similar to that of the fundamental form, to an equal horizontal projection with it. The number m being not yet determined, the coefficient of the subordinate series will be $= {}^{m+1}$; which, if $m+1$ be equal to any power of the number 2, shows the member to which it belongs to be a member of the principal series. The subordinate series, whose coefficient, besides powers of the number 2, contains the factor 3, is termed the *first*, and that which, in the same case, contains the factor 5, the *second* subordinate series. Members of the principal, of the first and of the second subordinate series, which are supposed to belong together, arrange themselves thus: $1 : \frac{3}{4} : \frac{5}{4}$, which numbers express the ratio between their axes. The designation and the position of the members in the subordinate series is evident from the foregoing. Mineralogy.

53. *Resolution of the Auxiliary Form*, § 41. *Horizontal Prisms.*

The only form now left for examination is the auxiliary form, § 41; which, as has been mentioned above, is not a simple one, its faces not being homologous. By enlarging only those planes which, amongst themselves, are equal and similar, there arise *two obliquangular four-sided prisms*, unlimited in the direction of their axis, and which, therefore, like all the prisms, are forms in which one dimension is infinite. The axes of the two prisms are perpendicular to each other, and have a horizontal position, if the fundamental form be in the upright position. These axes coincide with the diagonals of the basis of the fundamental form produced to an infinite length. Hence the prisms may be considered as scalene four-sided pyramids, one diagonal of which has become infinite; similarly to the *vertical* prisms, that are scalene four-sided pyramids of an infinite axis. For the sake of distinguishing them from these, they bear the name of *horizontal* prisms, and their general designation is $Pr+n$. More particularly, $\breve{P}r+n$ expresses the horizontal prism in which the longer diagonal, $\breve{P}r+\infty$ that in which the shorter diagonal of the fundamental form has remained a finite quantity.

54. *Series of Horizontal Prisms.*

Every scalene four-sided pyramid, whatever its properties may be, has its dependent horizontal prisms. To every series of such forms will, therefore, belong two series of horizontal prisms, to be distinguished by their designation according to the properties of those series. It is, however, remarked, that if we take the common values of m, as stated above, the angles of several members of those series, and, therefore, the series themselves, will be identical; and for this reason, one designation will suffice for them. Thus, the number of series of those forms taken together may be reduced to three pairs, of which the first pair belongs to the principal, the others to the subordinate series of scalene four-sided pyramids; each of the diagonals having one series referred to it. The horizontal prisms belonging to a scalene four-sided pyramid are produced, by placing tangent planes in its *homologous* terminal edges. If those terminal edges connect the terminal point of the axis with the long diagonal, the prism is said to belong, or to be referred, to the long; if they connect it with the short, it is said to belong, or to be referred, to the short diagonal of P. The horizontal prisms are remarkable forms, often to be met with in the natural combinations.

55. *Limits of the Series of Horizontal Prisms.*

By comparing the horizontal prisms belonging to members of a series of scalene four-sided pyramids it becomes evident how, whilst the axis of the pyramid increases, the angle of the horizon-

tal prism contiguous to the axis of the fundamental form becomes smaller and smaller; whilst the other, at the intersection of the planes from different apices, becomes greater and greater. If the axis of the pyramid become infinite, or the pyramid itself a vertical prism, the first of these angles will disappear, the second become $= 180^{\circ}$. Hence a horizontal prism is transformed, in this case, in a pair of unlimited parallel planes, perpendicular to the diagonals to which they belong. These planes, which may be considered as forms unlimited, as it were, in two directions, are the limits of the series of horizontal prisms, the axis of the pyramid to which they belong being infinite. The opposite limits, or those which appear, if the pyramid have an infinitely small axis, appear as faces perpendicular to the axis. The series of horizontal prisms between their limits may, accordingly, be represented thus:

$$\mathrm{P}-\infty \;\ldots\; \mathrm{P\breve{r}}+n \;\ldots\; \mathrm{P\breve{r}}+\infty$$

$$\mathrm{P}-\infty \;\ldots\; \mathrm{P\bar{r}}+n \;\ldots\; \mathrm{P\bar{r}}+\infty.$$

For having the designation in every respect complete, the coefficient of the series to which the horizontal prism belongs must be added to the sign for a particular member.

Although this is not a place for entering into the examination of combined forms, yet that peculiar combination which is produced by the two limits of the series of horizontal prisms, and takes the appearance of a vertical rectangular four-sided prism, not yet limited in the direction of its axis, cannot remain unnoticed. This combination is designated by $\mathrm{P\breve{r}}+\infty \,.\, \mathrm{Pr}+\infty$; it must carefully be distinguished from the rectangular four-sided prisms, limiting the series of isosceles four-sided pyramids, which, abstraction being made of the face perpendicular to the axis, are simple forms; a property not belonging to the rectangular prism in connection with the scalene four-sided pyramid.

56. *Derivations from the Hexahedron.*

Besides the rhomboid, the isosceles and the scalene four-sided pyramids, there is only one other form existing fit for being considered as a fundamental form, or which, without being derivable from any one of the former, can itself serve as basis to the derivation. This form is the *hexahedron*, Plate XCIX. fig. 11. There are, in connection with the hexahedron, a great number of other forms, remarkable for their properties, differing, however, from each other more by their general aspect than by their dimensions. The complete assemblage of those forms is obtained in the following way. Bring first the hexahedron in an upright position, so as to bring one of its corners uppermost, and the opposite perpendicularly below it, by which means the rhomboidal axis, passing the two corners, becomes vertical; then consider the possible situations of a moveable plane, tangent to the hexahedron in the uppermost point of the said rhomboidal axis. The different situations the plane can effect are seven in number; but in one of them it becomes parallel to the face of the hexahedron itself. Every one of these situations gives rise to a peculiar form; hence there will exist as many forms as the moveable plane can assume different situations, and no more. The forms thus obtained agree in several of their properties, particularly in respect of the kind, number, and situation of their axis, and are as follows: 1. The *hexahedron*, contained under six squares. 2. The *octahedron*, fig. 12, contained under eight equilateral triangles. 3. The *one-edged tetragonal dodecahedron* (fig. 13), contained under twelve rhombs. 4. The *hexahedral trigonal-icositetrahedron* (fig. 14), contained under twenty-four isosceles triangles, its prominent form being that of the hexahedron. 5. The *octahedral trigonal-icositetrahedron* (fig. 15), contained under twenty-four isosceles triangles, its prominent form being that of the octahedron. 6. The *two-edged tetragonal-icositetrahedron* (fig. 16), contained under twenty-four irregular tetragons, in which two of the opposite angles are equal; and 7. The *tetracontaoctahedron* (fig. 17), contained under forty-eight scalene triangles. The dimensions of the three first of these forms are constant, a property not to be met with in the others, of which, therefore, several varieties may be found differing from each other by their angles.

57. *Resolution of some of those Forms into Halves.*

This assemblage, though it is complete, seems not to contain all the forms in connection with the hexahedron, as they are produced by nature, such as, for instance, the tetrahedron, the pentagonal dodecahedrons, &c. Nevertheless it contains them; for they arise from a particular resolution of some of those mentioned in § 56. This resolution is effected by enlarging half of the number of planes to be met with in the form to be resolved, according to certain rules, and by making the rest of them disappear. The two forms which arise out of the resolution of one of the former are termed halves (not half forms, as as the simple four, six, or eight-sided pyramids), and can be easily distinguished by the lesser number of their axis, as some of those that are common to the original forms disappear by the resolution. The two halves are perfectly equal and similar to each other; they differ, however, amongst themselves by that position in which they are placed by the resolution. The position of one of the halves being considered as the *direct*, that of the other will be the *inverse*. The latter is changed into the former, by inverting the vertical rhomboidal axis of the form, so as to bring the upper apex lowermost, and *vice versa*. Thus the halves, produced from octahedron, are the two *tetrahedrons* (fig. 18, Plate XCIX.), contained under four equilateral triangles; those from the hexahedral trigonal-icositetrahedron, the two *hexahedral pentagonal dodecahedrons* (fig. 19), contained under twelve irregular pentagons, which have two pairs of equal angles; those from the octahedral trigonal-icositetrahedron, the *two-edged tetragonal dodecahedrons* (fig. 20), contained under twelve tetragonal faces, in which there is only one pair of equal angles; those from the two-edged tetragonal-icositetrahedron, the two *trigonal dodecahedrons* (fig. 21), contained under twelve isosceles triangles; and lastly, the halves of the tetracontaoctahedron, viz. *a*, the *tetrahedral trigonal-icositetrahedrons* (fig. 22), contained under twenty-four scalene

triangles; *b*, the *three-edged tetragonal-icositetrahedrons* (fig. 23), contained under twenty-four irregular tetragonal faces, in which there are not two equal angles; and *c*, the *pentagonal-icositetrahedrons* (fig. 24), contained under twenty-four irregular pentagons, whose angles are all different.

58. Resolution of some of the Halves into Fourths.

The three last, or those halves which are obtained from the tetracontaoctahedron, allow of a further dissolution into halves of the halves, or into *fourths*. These are the *tetrahedral pentagonal-dodecahedrons* (fig. 25), contained under twelve irregular pentagons, in which there are not two equal angles. The difference between *right* and *left*, to be met with in this form, and in the pentagonal-icositetrahedron, deserves some attention. If two-fourths are combined in the same position, which they assume in the resolution, the halves are produced; and if the halves, produced by this combination, are combined likewise in their proper position, they will reproduce the original form, out of which the halves as well as the fourths have been obtained by way of resolution. Most of the original forms and their halves are already known in several varieties of minerals; some of the latter, viz. the tetrahedral pentagonal-dodecahedrons, and the pentagonal-icosi-tetrahedrons, have not yet been found.

59. System of Crystallization and Series of Crystallization.

If only the *kind* of the fundamental form has been considered, the assemblage of the forms derived from it is called a *system of crystallization*; but if also notice has been taken of its dimensions, the assemblage of the derived forms receives the denomination of a *series of crystallization*. These two notions are of the same kind, and differ only by the number of objects they contain, the latter being a particular determination of the former; and both refer not so much to the mere aggregation of forms, as to the relations prevailing amongst them.

60. Denomination of the Systems of Crystallization.

The systems of crystallization, agreeing in number with the fundamental forms, of which there are four, receive their names according to those fundamental forms. That which has been derived from the rhomboid is called the *rhomboidal system*, because its forms agree with the rhomboid in their general properties; that which has been derived from the isosceles four-sided pyramid, for the same reason, the *pyramidal system*; that which has been derived from the scalene four-sided pyramid, the *prismatic system*, on account of the great number and variety of prisms it contains; and that which has been derived from the hexahedron, the *tessular system*, in order to intimate that there occurs no other system of crystallization in nature which shares in the general properties of the hexahedron. It is evident that any form, if known, will suffice for the determination of the system to which it belongs, even though this form be a limiting one. Only the right rectangular four-sided prism is an exception, since it may be a simple form in the tessular, a double combination $(\mathrm{P}-\infty\ .\ \mathrm{P}+\infty)$ in the pyramidal, and a triple combination $(\mathrm{P}-\infty\ .\ \breve{\mathrm{P}}\mathrm{r}+\infty\ .\ \bar{\mathrm{P}}\mathrm{r}+\infty)$ in the prismatic system. The consideration of the mere form does not decide at all in this case. Some of the means of removing this uncertainty will be explained hereafter.

61. Determination of the Series of Crystallization.

A series of crystallization is determined by any one of its members, which is no limiting form, if the dimensions of it are known. These dimensions, if they are not (like those of the hexahedron, the octahedron, &c.) constant, must be made out by direct measurement. From these the dimensions of any other member, or of the fundamental form, if it has not been measured itself, can be found, in compliance with the relations developed above. The series of crystallization proves of great importance for the determination of the natural history species in the mineral kingdom. It is also an external character of the utmost value in the character of the species. This character requires, therefore, the dimensions of a member of the series to be stated, of which the most eligible is the fundamental form. The limits do not determine the series of crystallization, since, in the rhomboidal and in the pyramidal system, they are common to all; in the prismatic, at least to those series which possess a similar transverse section. Hence the obtaining the limiting forms is not sufficient for the character of the natural history species.

62. General Laws of Combination.

The second advantage flowing from the above inquiries, consists in the accurate understanding of the qualities of combinations, and of the development of their most general laws. The first of these laws stands thus: *The forms which nature combines must belong to one series of crystallization.* The second, *The combination must be effected in that position of the several simple forms it contains, which the derivation assigns to them.* Upon these two laws depends the symmetry of the combinations, which, therefore, is not the *fundamental law of crystallization*.

63. Rhomboidal and Dirhomboidal Combinations.

An accurate investigation of the combinations is one of the most interesting parts of crystallography. Without entering into minute details, some of their relations may be shortly mentioned, as they convey general ideas of the connection between different forms, and as they are, therefore, of consequence in the system of arrangement and discrimination to be explained in this article.

Combinations of the rhomboidal system, produced by simple forms in such a manner that they appear in the combination with the full number of their faces, and in their proper position, are termed *rhomboidal* combinations. Such are the most common combinations in the rhomboidal system. Suppose, on the contrary, a rhomboid to combine with itself in a turned position, it will affect the shape of a simple form, and appear as an isosceles six-sided pyramid. It is termed a *dirhomboid*, and designated by $2(\mathrm{R}+n)$. The dirhomboids do not arrange themselves with the isosceles six-sided pyramids in the same se-

ries (§ 29), because there is a difference existing in the situation of the bases in the one and in the other, as becomes evident in considering the derivation. In a similar way, two equal scalene six-sided pyramids being combined in a turned position, produce a scalene twelve-sided pyramid, which has as little right as the dirhomboid to be ranked with the simple forms, although its faces are all equal and similar to each other. Combinations produced by, or containing forms of this kind, are termed *dirhomboidal* combinations.

64. *Hemi-rhomboidal and Hemi-dirhomboidal Combinations.*

It sometimes happens in the rhomboidal system, that the forms enter only with half the number of their faces into a combination. If these combinations contain simple forms, they are said to be *hemi-rhomboidal;* if they contain any of the above mentioned compound forms under this restriction, they are said to be *hemi-dirhomboidal.* A further distinction is to be made among such combinations, in as much as the faces contiguous to one apex are either parallel, or inclined to those of the other. The hemi-rhomboidal, or hemi-dirhomboidal, are said, in the first case, to be *of parallel,* in the other to be *of inclined* faces. An example will put the importance of this difference in its full light: Enlarge in a scalene six-sided pyramid the alternating faces contiguous to one apex, and, at the same time, those of the opposite apex, which are *parallel* to the former, the resultant form will take the appearance of a rhomboid, without in reality being a form of this kind. If, on the contrary, the faces enlarged on the opposite apex are *inclined* to those of the former, the resultant form is contained under six trapezoidal faces.

65. *Pyramidal and Hemi-pyramidal Combinations.*

A relation similar to that which in the rhomboidal system has been expressed by the name of hemi-rhomboidal, is equally found in the pyramidal system, and here it constitutes the *hemi-pyramidal* combinations. The hemi-pyramidal combinations *of parallel* faces refer only to the eight-sided pyramids, which by this affect the shape of isosceles four-sided pyramids, without partaking of their other properties; those *of inclined* faces refer also to the isosceles four-sided pyramids, which yield forms analogous to the tetrahedron, whilst the result of the scalene eight-sided pyramid is a particular form, contained under eight scalene triangles.

66. *Prismatic, Hemi-prismatic, and Tetarto-prismatic Combinations.*

The differences already mentioned are particularly remarkable in the prismatic system. From what has been said in respect to the other systems, it becomes evident what is meant by *prismatic* and by *hemi-prismatic* combinations. The latter expression refers also to one or to several prisms, whose axes are parallel, if they enter into the combinations with only half the number of their faces. A similar relation of forms in the present system, marked by the expression *tetarto-prismatic,* arises, when of a scalene four-sided pyramid only the fourth part, as to the number, of the faces appear in a combination. Such a combination can also be produced by oblique angular four-sided prisms, whose axes are perpendicular to each other, when only half the number of their faces is visible. The hemi and tetarto-prismatic combinations illustrate the *oblique,* the rectangular as well as the obliquangular prisms produced by nature. These belong altogether to the prismatic system, and none of them is a simple form.

The signs of the hemi-rhomboidal, hemi-pyramidal, and hemi-prismatic, are composed of the signs of the whole forms, and of the number 2, placed below them like a divisor; instead of the latter, the signs of the tetarto-prismatic combinations contain the number 4 as divisor.

67. *Tessular and Semi-tessular Combinations.*

Those combinations of the tessular system, into which no halves or fourths enter, are called *tessular* combinations, and in the present place they need no further explanation. Combinations of this system, however, containing halves, are termed *semi-tessular* combinations. These allow of a further distinction into semi-tessular combinations *of parallel faces,* and into those *of inclined* faces, as is the case in the hemi-rhomboidal and hemi-pyramidal combinations. The halves peculiar to the former are those in which every face is parallel to another, as the hexahedral pentagonal-dodecahedron, the three-edged tetragonal-icositetrahedron, and the general aspect of the forms undergoes thereby no alteration. The halves peculiar to the latter have not two faces parallel to each other, as the tetrahedron, the tetrahedral trigonal-icositetrahedron, &c., and the combination itself assumes, or at least approaches to a tetrahedral aspect.

Instead of crystallographic signs, *verbal* expressions are employed, in the characteristic part of this article, when describing the forms of the tessular system; because the use of the former is in the present system subject to much greater difficulties, without affording services either so beneficial or so numerous as in the other systems.

68. *Development of the Combinations.*

To develope a combination is to exhibit by itself each of the simple forms which it contains (§ 4). The determination of the kind of these forms has no difficulty whatever. The homologous planes of a combination being enlarged till the rest disappear, one of the forms after the other is produced. To find out their relations, upon the knowledge of which, nevertheless, depends the demonstration of the combinations, is somewhat more circumstantial, and here the series of simple forms, produced by the derivation, show their great utility. The following paragraph contains a general idea of the mode of proceeding followed for this purpose by crystallography, though its full explanation would require too much calculation to be given in this place.

69. *Line of Combination, General Formulæ for it, and their Application.*

Imagine a combination of two simple forms, whose dimensions are known, and which themselves are in

Mineralogy. such a position as is peculiar to the system of crystallization to which they belong. Suppose now two terminal edges, or two diagonals, or one terminal edge and one diagonal, that are situated in a plane which, at the same time, passes through the axis, to be prolonged, till they intersect each other above or below, in a finite or infinite distance from a horizontal plane, laid through the centre of the axis. The straight line measuring the distance between the mutual intersection of the two lengthened lines, and that in which one of the lines meets with the horizontal plane, is termed the *line of combination*. The length and situation of the line of combination are evidently dependent upon the dimensions of the combined forms; and inversely the situation of the edge of combination (§ 3.) is dependent upon the length and situation of the line of combination: for, join by a straight line the terminal point of the line of combination with one of the points of intersection between the edges and diagonals of the combined forms, amongst themselves or with each other, the prolongation of this line will equally pass through the other point of intersection, and therefore be identical with the edge of combination. Hence if two forms of a system, in a determined position, produce with a third form lines of combination equal both in length and situation, the edges of combination thus produced will be equally situated; and if the two forms enter at once into combination with the third, the edges of combination produced by the first and the third must be parallel to those between the second and the third.

Crystallography developes general formulæ, expressing the quantity of the line of combination respecting the three first systems of crystallization (this not being required for the tessular system), in which due notice is taken of the kind of forms, their position, and the quality of the edges of combination, namely, whether the faces producing them are contiguous to one or to different apices of the simple forms. Of these formulæ, that which answers to the circumstances of a given combination between two known simple forms, is chosen and determined for that particular case, by substituting, instead of the variable quantities, m and n occurring in them, those finite numbers, which depend upon the place of the members in the series, and those factors by which the axes of the rhomboids and others have been multiplied. Thus the quantity of the line of combination, expressed either by a terminal edge, or by a diagonal, or by the axis of one or the other form contained in the combination, is found. Another formula must now be chosen, answering to a combination between *one* of these known forms, and *another unknown*, which produces with it edges of combination parallel to those in the combination of the two known forms. The formula must be determined for the case in question, by the substitution of numbers to m and n. This can only be done in respect to the known form; m and n of the unknown remain unaltered in the expression. This expression, as is evident from the preceding, must be equal to the value of the line of combination found above. These two equal terms give an equation to be resolved for the values of m and n. Mineralogy.

If the unknown form contains only n (as for instance it being a rhomboid, where $m=1$), it is determined in the manner already mentioned. If, on the contrary, it contains m and n at once, another equation must be established in order to determine the second quantity, which is effected in the manner shown already. Some experience in this method of developing the combinations will teach how to take advantage of certain circumstances offering themselves, by which very often it is rendered possible to argue immediately upon one of the unknown quantities m or n, or even sometimes upon both, and to determine the relations of several forms, according to such arguments, without being obliged to employ calculations.

Every simple form being thus determined as member of a series, and furnished with its crystallographic sign; the combination containing those simple forms will be designated by writing the signs for the simple forms one after the other, as some instances in the preceding § 60. have already shown. As to the order in which the signs succeed each other in designating a combination, there are two distinct methods, each of which may be applied. Either those forms, whose planes are perpendicular to the axis, are set down first, those whose planes are parallel to it, last; the rest following each other according to the greater or less inclination which their faces have toward the axis, as decreasing from 90° to 0°; or the forms, according to their kind, are collected into series between their limits, and then set down one after the other. The designation

$$\begin{array}{ccccccc} R-1 \,. & (P-2)^3 \,. & R \,. & \frac{5}{4}R \,. & R+1 \,. & (P)^3 \,. & R+\infty \,. \\ a & b & c & d & e & f & g \end{array}$$

represents fig. 26, according to the first method,

$$\begin{array}{ccccccc} R-1 \,. & R \,. & R+1 \,. & \frac{5}{4}R \,. & R+\infty \,. & (P-2)^3 \,. & (P)^3 \\ a & c & e & d & g & b & f \end{array}$$

the same, after the second method.

70. *Calculation of the Angles at the Edges of Combination.*

After having developed the combination, the last office of crystallography is to calculate the angles of combination, or the incidences of the faces of different forms. In many instances this angle follows at once from those of the simple forms. If this will not do, crystallography employs general formulæ for the trigonometrical functions of the edge of combination, similar to those for the line of combination, containing equally the variable quantities m and n. The development of the combinations determines these quantities, and if substituted in the said formulæ, they give the value of a trigonometrical function, commonly of the co-sine of the angle, produced by two faces of different forms, meeting in the edge of combination. *

* For the preceding view of the New Crystallography we are indebted to Professor Mohs, who wrote it expressly for the present article.

II. Cleavage. *Foliated Fracture of Werner.*

Cleavage is the property which minerals possess of splitting in certain determinate directions. The faces or planes thus obtained, which are termed the *faces of the cleavage*, are more or less smooth and shining. The forms contained under these faces are called *forms of cleavage*, or *cleavage-forms*.

The cleavage-forms represent members of the series of crystallization of those mineral species to which the mineral having the cleavage belongs. The same may be inferred of such individuals or species as possess more than one cleavage form. Hence cleavage extends the application of crystallography in the mineral kingdom, because a mineral, although it be not crystallized, may be cleavable, and thus allow the series, at least the system of crystallization, to be made out by cleavage in most of the cases, where no regular crystallizations occur.

The cleavage-forms are designated like those of crystallization. Cleavage-forms, Mohs remarks, if among the number of those, which in the preceding pages served as a basis to the derivation, are by preference chosen for representing the fundamental form in the species to which they belong; as in rhomboidal calc-spar, the rhomboid of 105° 5′. This rule, however, suffers an exception in the case of a rhomboid or a pyramid, which occur as cleavage-forms, being too obtuse or too acute. For this reason, in pyramidal copper pyrites, the fundamental form is P, though the cleavage-form is P+1. No cleavage-form, whose dimensions are infinite, can be employed as a fundamental form.

A few technical expressions are employed by Mohs in determining the cleavage, of which the following may be enumerated. Cleavage, in the three first systems of crystallization, which are those of variable dimensions, is said to be *axotomous*,* when it appears as a single plane or face perpendicular to the axis; it is said to be *paratomous*,† if it is parallel to the faces of a finite form; and *peritomous*,‡ if it takes place parallel to the axis, and equally distinct in more than one direction. In the prismatic system, the expression *prismatoidal* means a single cleavage-face parallel to the axis; and *diprismatic* denotes the cleavage to be parallel at the same time to the faces of a vertical, and to those of a horizontal obliquangular four-sided prism. The expression *monotomous*, referring to the three systems, is more general than any of the foregoing; it comprises the axotomous and the prismatoidal, and is applied where a single cleavage-face is met with, whose position in regard to the axes, that is to say, whether it is parallel or perpendicular to the axis, has not been determined. The perfection or distinctness of the cleavage, which is next to be considered, refers to the aspect of the faces of the cleavage, viz. whether these are more or less smooth or shining, whether they are streaked, &c. The most important object to be remarked in this respect, is the sameness of quality existing in the faces belonging to one and the same, and the diversity of faces belonging to different cleavage-forms; the latter is a particular illustrated and confirmed by the derivations of the prismatic system. The nature of the faces of the cleavage is one of the means to remove the uncertainty mentioned in § 60, on account of the right rectangular prism. Lastly, it may be remarked, that we must be careful not to confound certain faces of composition (§ 86.), which sometimes likewise keep constant directions with the cleavage-forms.

III. Hardness.

The degrees of hardness or their limits are by Kirwan, Mohs, and others, expressed by numbers. The most precise scale of hardness is that of Mohs, in which the degrees are determined according to the following scale:

No. 1. denotes the degree of hardness of common talc and Venetian talc.

No. 2. is the hardness of a variety of prismatoidal gypsum, with an imperfect cleavage and imperfect transparency. Varieties perfectly transparent and crystallized are commonly too soft.

No. 3. Hardness of a cleavable variety of calcareous spar.

No. 4. Hardness of fluor spar.

No. 5. Hardness of apatite.

No 6. Hardness of prismatic felspar.

No. 7. Hardness of rhomboidal quartz.

No. 8. Hardness of prismatic topaz.

No. 9. Hardness of rhomboidal corundum.

No. 10. Hardness of octahedral diamond.

We must obtain such specimens of the minerals just enumerated as will answer for the required purpose. If we wish by means of them to ascertain the hardness of a given mineral, we first try which of the members of the scale can be scratched by one of the corners of the given mineral. We begin with the highest member of the scale, and proceed till we arrive at one which can be scratched. We now compare the hardness of the given mineral with that of the first member of the scale which can be scratched, and with that next to it which is not scratched, by passing corners of each of the same shape over the surface of a hard and fine file. The resistance which the minerals oppose to the file, and the noise produced by rubbing pieces of a nearly equal shape, allow the relation of the hardness in the given mineral to be estimated. The degree of hardness found in this way is expressed by the numbers in the scale, and if these are not sufficient, by decimals; the distance between two subsequent members being supposed to be divided into *ten* square parts, without, however, maintaining those distances in reality everywhere to be equal. Thus, if hardness is designated by H, that of prismatic gypsum, for example, which is 2, will be expressed H=2; tourmaline, which has a hardness intermediate between that of rhomboidal quartz and prismatic topaz, will be expressed by 7.5.

* From αξων, the axis, and τεμνω, I cut; cleavable in one direction.

† From παρα, beside, and τεμνω, I cut; with cleavage planes, which are parallel with the planes of the fundamental figure, or are inclined to the axis.

‡ From περι, round about, and τεμνω, I cut; with surrounding cleavage planes parallel to the axis.

IV. Specific Gravity.

The specific gravity of minerals is determined by means of the hydrostatic balance, the hydrometer, and Adie's new instrument. Of these instruments, and the modes of using them, accounts are given in the *Encyclopædia Britannica* and *Edinburgh Philosophical Journal.*

II. Characters employed in the description of the species, sub-species, kinds, and varieties of minerals.

1. *Colour.*—2. *Common and Particular External Forms.*—3. *Distinct Connections.*—4. *Surface.*—5. *Lustre.*—6. *Fracture.*—7. *Shape of Fragments.*—8. *Transparency.*—9. *Opalescence.*—10. *Streak.*—11. *Soiling.*—12. *Tenacity.*—13. *Frangibility.*—14. *Flexibility.*—15. *Adhesion to the Tongue.*—16. *Unctuosity.*—17. *Smell.*—18. *Taste.*

1. Colour.

The colours in the mineral kingdom are not so numerous as is generally imagined; and even the varieties, although often extremely beautiful, and apparently infinite in number, bear but a small proportion to the vast series that characterize the various productions of the vegetable and animal kingdoms. Werner, who bestowed great attention on this interesting and beautiful character, enumerates *eight principal colours,* viz. white, grey, black, blue, green, yellow, red, and brown. Each of these principal colours exhibits a greater or less number of varieties, many of which have been accurately defined, and are contained in the following enumeration.

I. *Definitions of the different Varieties of Colour.*

1. White.

1. *Snow-white* is the purest colour, and nearly agrees with that of new-fallen snow. Examples of this colour occur in Carrara marble and common quartz.

2. *Reddish-white* is snow-white with a slight intermixture of red. Example, red quartz.

3. *Yellowish-white* is snow-white with very little lemon-yellow and ash-grey. Example, chalk.

4. *Silver-white* is yellowish-white with metallic lustre. Example, arsenical pyrites.

5. *Greyish-white* is snow-white mixed with a little ash-grey. Example, quartz.

6. *Greenish-white* is snow-white mixed with a very little emerald-green and ash-grey. Example, amianthus.

7. *Milk-white* is snow-white mixed with a little Berlin-blue and ash-grey. The colour of skimmed milk. Example, calcedony.

8. *Tin-white* differs from the preceding colour, principally in containing a little more grey, and having the metallic lustre. Example, native antimony.

2. Grey.

1. *Lead-grey* is ash-grey with a small portion of blue, and possesses metallic lustre. Example, lead-glance.

2. *Bluish-grey* is ash-grey mixed with a little blue. Example, limestone.

3. *Pearl-grey* is pale bluish grey intermixed with a little red. Example, porcelain jasper.

4. *Smoke-grey,* or *brownish-grey,* is dark bluish grey mixed with a little brown. Example, flint.

5. *Greenish-grey* is ash-grey mixed with a little emerald-green, and has sometimes a faint trace of yellow. Example, clay-slate.

6. *Yellowish-grey* is ash-grey mixed with lemon-yellow and a minute trace of brown. Example, calcedony.

7. *Ash-grey* is the characteristic colour. It is the colour of wood ashes. Example, quartz.

8. *Steel-grey* is dark ash-grey with metallic lustre. It is the colour of newly broken steel. Example, native platina.

3. Black.

1. *Greyish-black* is velvet-black mixed with ash-grey. Example, basalt.

2. *Iron-black* is principally distinguished from the preceding by its being rather darker, and possessing a metallic lustre. Example, magnetic iron-ore.

3. *Velvet-black* is the characteristic colour of this series. It is the colour of black velvet. Example, obsidian.

4. *Pitch-black,* or *brownish-black,* is velvet-black mixed with a little yellowish-brown. Example, cobalt ochre.

5. *Greenish-black,* or *raven-black,* is velvet-black mixed with a little greenish-grey. Example, hornblende.

6. *Bluish-black* is velvet-black mixed with a little blue. Example, black earthy cobalt ochre.

4. Blue.

1. *Blackish-blue* is Berlin-blue mixed with much black, and a trace of red. Example, blue copper.

2. *Azure-blue* is Berlin-blue mixed with a little red. Example, blue copper.

3. *Violet-blue* is Berlin-blue mixed with much red and very little black. Example, amethyst.

4. *Lavender-blue* is violet-blue mixed with a small portion of grey. Examples, lithomarge and porcelain jasper.

5. *Plum-blue* is Berlin-blue, with more red than in violet-blue, and a small portion of brown and black. Example, spinel.

6. *Berlin-blue* is the purest or characteristic colour of the series. Examples, sapphire, rock-salt, kyanite.

7. *Smalt-blue* is Berlin-blue, with much white, and a trace of green. Examples, pale-coloured smalt, named eschel, earthy blue iron, earthy blue copper, and some varieties of gypsum.

8. *Duck-blue* is a dark blue colour, composed of blue, much green, and a little black. Example, ceylanite.

9. *Indigo-blue* is a deep blue colour, composed of blue, with a considerable portion of black, and a little green. Example, earthy blue iron of Eckardsberg, in Thuringia.

10. *Sky-blue* is a pale blue colour, composed of blue, green, and a little white. It is the colour of a clear sky, hence its name. Example, lenticular copper.

Mineralogy.

5. Green.

1. *Verdigris-green* is emerald-green mixed with much Berlin-blue and a little white. Example, copper-green and green Siberian felspar.

2. *Celandine-green* is verdigris-green mixed with ash-grey. Examples, green earth, Siberian and Brazilian beryl.

3. *Mountain-green* is emerald-green mixed with much blue, and a little yellowish-grey; or verdigris-green with yellowish-grey. Examples, beryl and glassy actynolite.

4. *Leek-green* is emerald-green, with bluish-grey and a little brown. Examples, nephrite and common actynolite.

5. *Emerald-green* is the characteristic or pure unmixed green. Example, emerald.

6. *Apple-green* is emerald-green mixed with a little greyish-white. Example, chryoprase.

7. *Grass-green* is emerald-green mixed with a little lemon yellow. Example, uranite.

8. *Blackish-green* is pistachio-green mixed with a considerable portion of black. Example, augite.

9. *Pistachio-green* is emerald-green mixed with more yellow than in grass-green, and a small portion of brown. Examples, chrysolite and epidote.

10. *Asparagus-green* is pistachio-green mixed with a little greyish white; or emerald-green mixed with yellow and a little brown. Examples, garnet, olivenite, and beryl.

11. *Olive-green* is grass-green mixed with much brown, and a little grey. Examples, common garnet, olivenite, and pitch-stone.

12. *Oil-green* is emerald-green mixed with yellow, brown, and grey; or pistachio-green, with much yellow and light ash-grey. Examples, fuller's-earth and beryl.

13. *Siskin-green* is emerald-green mixed with much lemon-yellow and a little white. Example, uran mica.

6. Yellow.

1. *Sulphur-yellow* is lemon-yellow mixed with much emerald-green and white. Example, native sulphur.

2. *Brass-yellow* differs from the preceding yellow principally in having metallic lustre; it contains a small portion of grey. Example, copper pyrites.

3. *Straw-yellow* is sulphur-yellow mixed with much greyish-white. Example, yellow cobalt ochre.

4. *Bronze-yellow* is brass-yellow mixed with a little steel grey and a minute portion of reddish-brown. Example, iron pyrites.

5. *Wax-yellow* is lemon-yellow mixed with reddish-brown and a little ash-grey; or it may be considered as honey-yellow with greyish-white. Examples, opal and yellow lead-spar.

6. *Honey-yellow* is sulphur-yellow mixed with chesnut-brown. Examples, fluor-spar and beryl.

7. *Lemon-yellow* is the pure unmixed colour. It is the colour of the rind of ripe lemons. Example, yellow orpiment.

8. *Gold-yellow* is the preceding colour with metallic lustre. Example, native gold.

9. *Ochre-yellow* is lemon-yellow mixed with a considerable quantity of light chesnut-brown. Examples, yellow earth and jasper.

10. *Wine-yellow* is lemon-yellow mixed with a small portion of red and greyish-white. Examples, Saxon and Brazilian topaz.

11. *Cream-yellow*, or *Isabella-yellow*, contains more red and grey than the wine-yellow, and also a little brown. Examples, bole from Strigau and compact limestone.

12. *Orange-yellow* is lemon-yellow with carmine-red. It is the colour of the rind of the ripe orange. Example, uran-ochre.

7. Red.

1. *Aurora*, or *morning-red*, is carmine-red mixed with much lemon-yellow. Example, red orpiment.

2. *Hyacinth-red* is carmine-red mixed with lemon-yellow, and a minute portion of brown; or aurora-red mixed with a minute portion of brown. Examples, hyacinth and tile-ore.

3. *Tile-red* is hyacinth-red mixed with greyish-white. The colour of tiles or bricks. Example, porcelain jasper.

4. *Scarlet-red* is carmine-red mixed with a very little lemon-yellow. Example, light-red cinnabar from Wolfstein.

5. *Blood-red* is scarlet-red mixed with a small portion of black. Examples, pyrope and jasper.

6. *Flesh-red* is blood-red mixed with greyish-white. Examples, felspar and calc-spar.

7. *Copper-red* scarcely differs from the preceding variety, but in possessing metallic lustre. Example, native copper.

8. *Carmine-red* is the characteristic colour. Example, spinel, particularly in thin splinters.

9. *Cochineal-red* is carmine-red mixed with bluish-grey. Example, dark-red cinnabar.

10. *Crimson-red* is carmine-red mixed with a considerable portion of blue. Example, oriental ruby.

11. *Columbine-red* is carmine-red with more blue than the preceding variety, and, what is characteristic for this colour, a little black. Example, precious garnet.

12. *Rose-red* is cochineal-red mixed with white. Examples, red manganese and quartz.

13. *Peach-blossom-red* is crimson-red mixed with white. Example, red cobalt-ochre.

14. *Cherry-red* is crimson-red mixed with a considerable portion of brownish-black. Examples, spinel, red antimony, and precious garnet.

15. *Brownish-red* is blood-red mixed with brown. Example, clay iron-stone.

8. Brown.

1. *Reddish-brown* is chesnut-brown mixed with a little red and yellow; or chesnut brown with a small portion of aurora-red. Example, brown-blende from the Hartz.

2. *Clove-brown* is chesnut-brown mixed with cochineal-red and a little black. It is the colour of the clove. Examples, rock-crystal and brown hematite.

3. *Hair-brown* is clove-brown mixed with ash-grey. Example, wood-opal.

4. *Broccoli-brown* is chesnut-brown mixed with much blue, and a small portion of green and red. Example, zircon.

5. *Chesnut-brown* is the characteristic or pure brown colour. Example, Egyptian jasper.

6. *Yellowish-brown* is chesnut-brown mixed with a considerable portion of lemon-yellow. Examples, iron-flint and jasper.

7. *Pinchbeck-brown* is yellowish-brown with metallic lustre. Rather the colour of tarnished pinchbeck. Example, mica.

8. *Wood-brown* is yellowish-brown mixed with much pale ash-grey. Examples, mountain wood and bituminous wood.

9. *Liver-brown* is chesnut-brown mixed with olive-green and ash-grey. The colour of boiled liver. Example, common jasper.

10. *Blackish-brown* is chesnut-brown mixed with black. Examples, mineral pitch from Neufchatel and moor-coal.

II. *The Play of the Colours.*

If we look on a mineral which possesses this property, we observe, on turning it slowly, besides its common colours, many others, which are bright, change very rapidly, and are distributed in small spots. We observe it in the diamond when cut, and in precious opal.

III. *The Changeability of the Colours.*

When the surface of a mineral, which we turn in different directions, exhibits, besides its common colours, different bright colours, that do not change so rapidly, are fewer in number, and occur in larger patches than in the play of the colour, it is said to exhibit what is called the changeability of the colours. The changeability of colour is seen only in particular directions, the play of colour in all directions.

We distinguish two kinds of this phenomenon.

1*st*, That which is observed by looking in different positions *on* the mineral, as in Labrador felspar.

2*d*, That observed by looking *through* it, as in the common opal, which shows a milk-white colour when we look on its surface, but when held between the eye and the light is wine-yellow.

IV. *The Iridescence.*

When a mineral exhibits the colours of the prism or the rainbow, arranged in parallel, and sometimes variously curved layers, it is said to be iridescent. It is to be observed by,

1*st*, Looking *on* the mineral only, as in precious opal, adularia, &c.

2*d*, Both by looking *on* the mineral and *through* it, as in calcareous spar crossed by thin veins, some arragonites, rainbow calcedony, and some amethysts.

V. *Tarnished Colours.*

A mineral is said to be tarnished when it shows on its external surface, or on that of the distinct concretions; fixed colours different from those on its interior or fresh fracture.

Tarnished colours are *simple* or *variegated.*

I. *Simple.*

a. Grey,—white cobalt.

b. Black,—native arsenic.

c. Brown,—magnetic pyrites.

d. Reddish,—native bismuth.

II. *Variegated.*

The variegated, or party-coloured, are distinguished according to the colour of their basis. Of these the following are enumerated in the tabular view.

a. Pavonine, or *peacock-tail tarnish.* This is an assemblage of yellow, green, blue, red, and brown colours, on a yellow ground. The colours are nearly equal in proportion, and are never precisely distinct, but always pass more or less into one another. Example, copper pyrites.

b. Iridescent, or *rainbow tarnish.* In this variety the colours are red, blue, green, and yellow, on a grey ground. It is more beautiful and brighter than the preceding. Example, specular iron-ore or iron-glance of Elba.

c. Columbine, or *pigeon-neck tarnish.* The colours are the same as in the preceding, with this difference, that the tints of colour are paler, and the red predominates. Example, native bismuth of Schneeberg.

d. Tempered-steel tarnish. It consists of very pale blue, red, green, and very little yellow, on a grey ground. Example, grey cobalt.

II. Common and Particular External Forms

1. *Common External Shape.*

Common external shapes are those in which there are neither a determinate number of planes meeting under determinate angles, nor any resemblance to known natural or artificial bodies. As they occur more frequently than the other shapes, they are named *Common external shapes.*

Six different kinds are enumerated by Werner, which are distinguished according to their relative length, breadth, and thickness, their relative magnitude, and their connections with other minerals. The kinds are *massive, disseminated, in angular pieces, in grains, in plates, and in membranes.*

1. *Massive* is that common external shape which is from the size of a hazel-nut to the greatest magnitude, and whose dimensions, in length, breadth, and thickness, are nearly alike. It occurs imbedded in other minerals, and it is intermixed with them at their line of junction. Example, Galena or lead-glance.

2. *Disseminated* is from the size of a hazel-nut until it is scarcely visible, and its dimensions, in length, breadth, and thickness, are nearly alike. It is imbedded, and is intermixed with the inclosing mineral at the line of junction.

3. *In angular pieces.* Minerals having an angular shape, in which the length, breadth, and thickness are nearly alike, which are found loose, or slightly imbedded, and without any intermixture with the inclosing mineral at the line of junction, and from the size of a hazel-nut and upwards, are said to occur in angular pieces. It is distinguished from the massive by its occurring either loose, or not intermixed with the basis at the line of junction. Of this external shape there are two kinds:

a. Sharp-cornered, as in *quartz.*

b. Blunt-cornered, as in *common opal.*

4. *In grains.* Minerals having a roundish form, and imbedded or loose, and not much larger than a hazel-nut, are said to occur in grains.

5. *In plates.* Minerals which occur in external shapes, whose length and breadth are great in comparison of their thickness, in which the thickness is not equal throughout, and is so considerable as to allow the fracture to be distinguished, are said to occur in plates. The maximum thickness of plates is half an inch. Example, red silver.

6. *In membranes* or *flakes.* This shape is distinguished from the former by its thinness, as it never greatly exceeds the thickness of common paper, and the fracture cannot be seen. Example, iron pyrites.

II. Particular External Shape.

Particular external shapes differ from the common external shapes, in bearing a resemblance to natural or artificial bodies, and in being far more characteristic and varied in their aspect. There are four different sets, entitled, *longish, roundish, flat,* and *cavernous.*

1. *Longish particular external shapes.*

a. Dentiform. Adheres by its thick extremity, and becomes gradually thinner, incurvated, and at length terminates in a free point, so that it resembles a canine tooth, whence its name. Example, native silver.

b. Filiform. Adheres by its thicker extremity, and terminates by an almost imperceptible diminution of thickness, and is usually curved in different directions. It is thinner and longer than the dentiform. Example, native silver.

c. Capillary. When the filiform becomes longer and thinner, it forms the capillary. It is generally much entangled, and sometimes the threads are so near each other that it passes into the compact. Example, native silver.

d. Reticulated is composed of many straight threads, which are sometimes parallel and sometimes meet each other at right angles, and form a net-like shape. Example, native silver.

e. Dendritic. In this external shape we can observe a trunk, branches, and twigs, which are distinguished from each other by their thickness, the trunk being the thickest. Example, native copper.

f. Coralloidal. When two or three branches, having rounded or pointed extremities, proceed from one stem, the coralloidal external shape is formed. There are usually many stems together. Example, calc-sinter.

g. Stalactitic. A mineral is said to possess a stalactitic external shape, when it consists of different straight, more or less lengthened rods, which are thickest at their attachment, and become narrower at their free extremity, which is rounded or pointed. Example, calc-sinter.

h. Cylindrical consists of long, rounded, straight, imperforated, usually parallel rods, which are attached at both extremities, and are generally thicker at the extremities than the middle. The interstices are either empty or filled up with another mineral. Example, galena or lead-glance.

i. Tubiform consists of long, usually single, perforated tubes, which are somewhat longitudinally knotty. Example, calc-sinter.

k. Claviform is the reverse of *stalactitic;* it is composed of club-shaped parallel rods, which adhere by their thin extremities. Example, compact black hematite.

l. Fruticose. This external shape has the appearance of cauliflower. Example, calc-sinter.

2. *Roundish Particular External Shapes.*

a. Globular. Under this are comprehended:

- *α. Perfect globular* or *spherical,* as in alum-slate.
- *β. Imperfect globular,* as in calcedony.
- *γ. Ovoidal* or *elliptical.* Examples, rounded masses of quartz in puddingstone.
- *δ. Spheroidal.* When the spherical is compressed the spheroidal is formed. Example, Egyptian jasper.
- *ε. Amygdaloidal.* When the ovoidal is compressed in the direction of its length, the amygdaloidal is formed. Example, zeolite.

b. Botryoidal consists of large segments of small balls, which are irregularly heaped together, and have many interstices. It resembles grapes, whence its name. Example, hematite.

c. Reniform consists of small segments of large balls, which are so closely set together, that no interstices are formed. Example, calcedony.

d. Tuberose. This shape consists of irregular roundish or longish elevations and depressions. Example, flint.

e. Fused-like or *liquiform.* This consists of numerous very flat rounded elevations, which are generally depressed in the middle. Example, lead-glance.

3. *Flat Particular External Shapes.*

a. Specular has on one side, seldom on two opposite sides, a straight smooth shining surface. It occurs in veins. Example, galena or lead-glance.

b. In leaves. In this external shape there are thin leaves, which are either irregularly curved, or are straight, and have throughout the same thickness. It occurs frequently in native gold.

4. *Cavernous Particular External Shapes.*

a. Cellular. A mineral is said to be cellular, when it is composed of straight or bent tables, which cross each other in such a manner as to form empty spaces or cells. Example, quartz.

b. Impressed. That is, when one mineral shows the impression of any particular or regular external shape of another mineral. It borders on the cellular shape, and is formed when a newer mineral is deposited over an older, the form of which it assumes, and retains even after the impressing mineral has been destroyed or removed.

c. Perforated consist of long vermicular cavities, which occupy but an inconsiderable portion of the mass, and terminate on the surface in small holes. When the holes become very numerous, it passes into spongiform. Example, bog iron-ore.

d. Corroded. A mineral is said to be corroded when

 it is traversed with numerous hardly perceptible roundish holes. Example, quartz.

e. Amorphous is composed of numerous roundish and angular parts that form inequalities, between which there are equally irregular hollows. Example, silver-glance or sulphuretted silver.

f. Vesicular. When a mineral has distributed through its interior many single, usually round, elliptical, and spheroidal, also amygdaloidal, or irregularly-shaped cavities, it is said to be vesicular. Example, wacke and lava.

III. Distinct Concretions.

Distinct concretions are those parts into which minerals are naturally divided, and which can be separated from one another, without breaking through the solid or fresh part of the mineral. In describing them, we have to attend to the following appearances. 1. Their shape; 2. Their surface; and, 3. Their lustre.

1. *Shape of the Distinct Concretions.*

They are granular, lamellar, prismatic, radiated, and fibrous.

1. *Granular distinct concretions* are those in which the length, breadth, and thickness, are nearly alike. Primitive limestone or marble is composed of granular distinct concretions.

2. *Lamellar distinct concretions* are those in which the length and breadth are nearly equal, and much more considerable than the thickness Lamellar heavy-spar affords a good example of this kind of concretion.

3. *Prismatic distinct concretions* are those in which the length is very considerable, in comparison of the thickness, or in the form of irregular prisms. Examples, amethyst and prismatic heavy spar.

4. *Radiated distinct concretions* are those in which the form is then prismatic, differing from the preceding in being narrower, and in having the form of rays. The *radiated fracture* of Werner belongs to this division. Example, radiated iron pyrites.

5. *Fibrous distinct concretions* are those in form of fibres. The *fibrous fracture* of Werner is included under this head. Example, actynolite.

2. *Surface of the Distinct Concretions.*

The surface varies considerably; in some it is *smooth*, as in hematite; in others it is *streaked*, as in schorl, or it is uneven, as in hornblende.

3. *Lustre of the Distinct Concretions.*

Here the varieties of lustre are the same as already enumerated, and therefore require no particular illustration.

IV. Surface.

The following are the varieties of this character:

1. *Uneven.* This, of all the kinds of external surface, presents the greatest and most irregular elevations and depressions, yet they are not so considerable as to alter the external shape. Example, surface of balls of calcedony.

2. *Granulated.* When the surface appears like shagreen, it is said to be granulated.

3. *Rough.* This kind of surface is marked with small scarcely visible elevations, which we can hardly discover but by the feel. It has little or no lustre. Example, rolled pieces of common quartz.

4. *Smooth.* Here there is no perceptible inequality, and the surface reflects more light than the preceding kinds of external surface. Example, fluor-spar.

5. *Streaked.* This kind of surface is marked with line-like elevations. It is either *simply streaked* or *doubly streaked.*

a. Simply streaked, when the line-like elevations run but in one direction.

- *α. Longitudinally streaked.* When the streaks are parallel with the length of the lateral planes. Example, topaz.
- *β. Transversely streaked.* When the streaks are parallel with the breadth of the lateral planes. Example, rock-crystal.
- *γ. Diagonally streaked.* When the streaks are parallel with the diagonal of the planes. Example, garnet.
- *δ. Alternately streaked.* When transverse and longitudinal streaks occur on alternate planes. Example, cubic iron-pyrites.

b. Doubly streaked, when the streaks run in different directions. This is of two kinds.

- *α. Plumiformly.* When the streaks run obliquely towards a principal streak, like the disposition of the parts of a feather. Example, plumose native bismuth.
- *β. Reticularly.* When the streaks either cross each other in a promiscuous manner, or under right angles, forming a kind of flat net-work. Example, silver-white cobalt.

c. Drusy. When a crystal is coated with a number of minute crystals of the same kind as the mineral itself, so that the new surface acquires a scaly aspect, it is denominated drusy. Example, common iron-pyrites.

V. Lustre.

Here we have to consider the *intensity* and the *sort* of lustre.

1. *The Intensity of the Lustre. Of this there are five different degrees.*

1. *Splendent.* A fossil is said to be splendent, when in full day-light (not in the sun-shine) it is visible at a great distance. Example, galena or lead-glance.

2. *Shining.* When a mineral at a distance reflects but a weak light, it is said to be shining. Example, heavy-spar.

3. *Glistening.* This degree of lustre is only observable when the mineral is near us, and at no greater distance than arms-length. Example, porcelain-jasper.

4. *Glimmering.* If the surface of a mineral, when held near to the eye in full and clear day-light, presents a very great number of small faintly shining points, it is said to be glimmering. Example, red hematite.

5. *Dull.* When a mineral does not reflect any light, or is entirely destitute of lustre, it is said to be dull. Example, chalk.

2. *The Sort of Lustre.*

The following are the different kinds of lustre:

1. *Metallic lustre,* which is always combined with opacity. It is divided into *perfect* and *imperfect.* The perfect occurs in native metals, the imperfect in tantalum ore.

2. *Adamantine.* Of this lustre there are two varieties, viz. *metallic adamantine,* and *common adamantine.* White lead spar is an example of the first, and diamond of the second.

3. *Pearly* is divided into *common* and *metallic-like.* Mica is an example of the first, and schiller-spar of the second.

4. *Resinous* or *waxy.* Example, pitch-stone.

5. *Vitreous* or *glassy.* Example, rock-crystal.

VI. The Fracture.

Fracture surfaces, or planes, are those produced on breaking a mineral. The following are the principal kinds:

1. *Splintery.* When, on a nearly even fracture surface, small wedge-shaped or scaly parts are to be observed, which adhere by their thicker ends, and allow light to pass through, we say that the fracture is splintery. It sometimes passes into even. Example, quartz.

2. *Even* is that kind of fracture in which the surface is nearly even, or without inequalities. Example, Lydian-stone.

3. *Conchoidal* is composed of concave and convex roundish depressions and elevations, which are more or less regular. When regular, they are accompanied with concentric ridges, as in many shells, and hence present a conchoidal appearance. Example, obsidian.

4. *Uneven.* In this kind of fracture the surface is marked with numerous angular elevations. These inequalities are termed the *grain,* so that we have *coarse* and *fine-grained* uneven fractures. Example, copper-pyrites.

5. *Earthy.* When the fracture-surface shows a great number of very small elevations and depressions, which make it appear rough, it is called earthy. Example, chalk.

6. *Hackly.* When the fracture-surface consists of numerous small slightly-bent sharp inequalities, it is said to be hackly. Example, native copper.

7. *Slaty.* In this kind of fracture the mineral splits into tables or slates which are more or less perfect. Example, common roof-slate.

VII. The Shape of the Fragments.

Fragments are those shapes which are formed when a mineral is so forcibly struck, that masses, having surrounding fracture-surfaces, are separated from it.

The fragments are either *regular* or *irregular.*

I. *Regular fragments* are inclosed in a certain number of regular planes, that meet under determinate angles. The following are the varieties of regular fragments:

1. *Cubic,* which occur in minerals possessing a rectangular three-fold cleavage, as galena, or lead-glance, and rock-salt.

2. *Rhomboidal,* or *oblique-angular,* which occur in minerals having a three-fold cleavage, as calcareous-spar.

3. *Tetrahedral,* or *three-sided pyramidal* and *octahedral,* occur in minerals having a four-fold cleavage, in which the folia meet under equal angles, as in fluor-spar.

4. *Dodecahedral.* Fragments of this form occur in minerals having a six-fold cleavage. Example, rock-crystal.

II. *Irregular fragments* are such as have no regular form. The following are the different varieties:

1. *Cuneiform,* in which the breadth and thickness are much less than the length, and gradually and regularly diminish in magnitude from one end to the other. Example, radiated zeolite.

2. *Splintery,* in which the breadth and thickness are less considerable than the length, but without diminution of magnitude from one extremity to the other. Example, asbestus.

3. *Tabular,* in which the breadth and length are more considerable than the thickness. Example, clay-slate.

4. *Indeterminate angular,* in which the length, breadth, and thickness, are in general nearly alike, but the edges differ much in regard to sharpness, which gives rise to the following distinctions:

a. Very sharp-edged, as in obsidian.
b. Sharp-edged, as in common quartz.
c. Rather sharp-edged, as in basalt.
d. Rather blunt-edged, as in pumice.
e. Blunt-edged, as in gypsum.
f. Very blunt-edged, as in loam.

VIII. The Transparency.

This character presents the five following degrees:

1. When a mineral, either in thick or thin pieces, allows the rays of light to pass through it so completely, that we can clearly distinguish objects placed behind it, it is said to be transparent. It is either *simply transparent,* that is, when the body seen through it appears single, as in mica and selenite; or *duplicating,* when the body seen through it appears double, as in calcareous-spar.

2. *Semi-transparent.* When objects can be discerned only through a thin piece, and then always appear as if seen through a cloud. Example, calcedony.

3. *Translucent.* When the rays of light penetrate into the mineral and illuminate it, but objects cannot be observed either through thick or thin pieces, it is said to be translucent. Example, pitch-stone.

4. *Translucent on the edges.* When light shines through the thinnest edges and corners, or when the edges are illuminated in the same degree as the whole mineral in the immediately preceding variety of transparency, it is said to be translucent on the edges. Example, hornstone.

5. *Opaque.* When, even on the thinnest edges of a mineral, no light shines through, it is said to be opaque, as in chalk.

IX. The Opalescence.

Some minerals, when held in particular directions, reflect from single spots in their interior, a coloured shining lustre, and this is what is understood by opalescence.

X. The Streak.

By the streak we understand the appearance which minerals exhibit when scratched or rubbed with a hard body, as a knife or steel. In some instances, the colour of the mineral is changed; in others, the lustre, and frequently neither colour nor lustre are altered.

XI. The Soiling or Colouring.

When a mineral, taken between the fingers, or drawn across another body, leaves some particles, or a trace, it is said to *soil* or *colour*.

XII. The Tenacity.

By tenacity is understood the relative mobility, or the different degrees of cohesion of the particles of minerals. The degrees of tenacity are the following:

1. *Brittle.* A mineral is said to be brittle, when, on cutting it with a knife, it emits a grating noise, and the particles fly away in the form of dust, and leave a rough surface, which has in general less lustre than the fracture. Example, quartz.
2. *Sectile or Mild.* On cutting minerals possessing this degree of tenacity, the particles lose their connection in a considerable degree, but this takes place without noise, and they do not fly off, but remain on the knife. Example, galena or lead-glance.
3. *Ductile.* Minerals possessing this degree of tenacity can be cut into slices with a knife, and extended under the hammer. Example, native gold.

XIII. The Frangibility.

By frangibility is understood the resistance which minerals oppose, when we attempt to break them into pieces or fragments. It must not be confounded with hardness. Quartz is hard, and hornblende comparatively soft; yet the latter is much more difficultly frangible than the former.

XIV. The Flexibility.

This term expresses the property possessed by some minerals, of bending without breaking. Flexible minerals are either *elastical flexible*, that is, if when bent they spring back again into their former direction, as mica; or *common flexible*, when they can be bent in different directions without breaking, and remain in the direction in which they have been bent, as molybdena, gypsum, talc, asbestus, and all malleable minerals.

XV. Adhesion to the Tongue.

This character occurs only in such minerals as possess the property of absorbing moisture, which causes them to adhere to the tongue. Example, meerschaum.

XVI. The Unctuosity.

Some minerals feel *greasy*, others *meagre*; and in

order to distinguish the different degrees of greasiness, the following distinctions are employed:

1. *Very greasy*, as talc and graphite.
2. *Greasy*, as steatite and fuller's earth.
3. *Rather greasy*, as asbestus and polished serpentine.
4. *Meagre*, as cobalt.

XVII. The Smell.

Of this we can give no definition, and shall therefore illustrate it by the minerals in which it occurs. It is observed under the three following circumstances:

1. *Spontaneously emitted;* in which case it is,
   - *a. Bituminous*, as mineral oil and mineral pitch.
   - *b. Faintly sulphureous*, as natural sulphur.
   - *c. Faintly bitter*, as radiated grey antimony.
2. *After breathing on it*, in which a *clayey-like* smell is produced, as in hornblende and chlorite.
3. *Excited by friction.*
   - *a. Urinous*, in stink-stone.
   - *b. Sulphureous*, in iron pyrites.
   - *c. Garlick-like*, or *arsenical*, in native arsenic and arsenic-pyrites.
   - *d. Empyreumatic*, in quartz and rock-crystal.

XVIII. The Taste.

This character occurs principally in the saline class, for which it is highly characteristic.

The varieties of it are,

1. *Sweetish taste*, common salt.
2. *Sweetish astringent*, natural alum and rock butter.
3. *Styptic*, blue and green vitriol.
4. *Saltly bitter*, natural Epsom salt.
5. *Saltly cooling*, nitre.
6. *Alkaline*, natural soda.
7. *Urinous*, natural sal-ammoniac.

System of Arrangement of Simple Minerals.

CLASS I.

Order I.—Gas.

Genus I. Hydrogen Gas.
1. Pure Hydrogen Gas.
2. Carburetted Hydrogen Gas.
3. Sulphuretted Hydrogen Gas.
4. Phosphuretted Hydrogen Gas.

Genus II. Atmospheric Air.
1. Pure Atmospheric Air.

Order II.—Water.

Genus I. Atmospheric Water.
1. Pure Atmospheric Water.

Genus II. Sea Water.
1. Common Sea Water.

Order III.—Acid.

Genus I. Carbonic Acid.
1. Aeriform Carbonic Acid.

Genus II. Muriatic Acid.
1. Aeriform Muriatic Acid.

Genus III. Sulphuric Acid.
1. Aeriform Sulphuric Acid.

2. Liquid Sulphuric Acid.

Genus IV. Boracic Acid.
1. Prismatic Boracic Acid.

Genus V. Arsenic Acid.
1. Octahedral Arsenic Acid.

Order IV.—Salt.

Genus I. Natron.
1. Prismatic Natron.

Genus II. Glauber Salt.
1. Prismatic Glauber Salt.

Genus III. Nitre.
1. Prismatic Nitre.

Genus IV. Rock Salt.
1. Hexahedral Rock Salt.

Genus V. Sal-Ammoniac.
1. Octahedral Sal Ammoniac.

Genus VI. Vitriol.
1. Hemiprismatic Vitriol, or Green Vitriol.
2. Prismatic Vitriol, or Blue Vitriol.
3. Pyramidal Vitriol, or White Vitriol.

Genus VII. Epsom Salt.
1. Prismatic Epsom Salt.

Genus VIII. Alum.
1. Octahedral Alum.

Genus IX. Borax.
1. Prismatic Borax.

Genus X. Glauberite.
1. Prismatic Glauberite.

CLASS II.

Order I.—Haloide.

Genus I. Gypsum.
1. Prismatoidal Gypsum, or Common Gypsum.
2. Prismatic Gypsum, or Anhydrite.

Genus II. Cryolite.
1. Prismatic Cryolite.

Genus III. Alum Stone.
1. Rhomboidal Alum Stone.

Genus IV. Fluor.
1. Octahedral Fluor.

Genus V. Apatite.
1. Rhomboidal Apatite.

Genus VI. Limestone.
1. Prismatic Limestone, or Arragonite.
2. Rhomboidal Limestone.
3. Macrotypous Limestone.
4. Brachytypous Limestone, or Rhomb-Spar.

Order II.—Baryte.

Genus I. Sparry Iron.
1. Rhomboidal Sparry Iron.
* *Sphærosiderite.*

Genus II. Red Manganese.
1. Rhomboidal Red Manganese.
* *Manganese Spar.*

Genus III. Calamine.
1. Prismatic, or Electric Calamine.
2. Rhomboidal Calamine.

Genus IV. Tungsten, or Scheelium.
1. Pyramidal Tungsten.

Genus V. Baryte.
1. Pyramido-prismatic Baryte, or Strontianite.
2. Di-Prismatic Baryte, or Witherite.
3. Prismatic Baryte, or Heavy-Spar.
4. Prismatoidal Baryte, or Celestine.

Genus VI. Lead-Spar.
1. Di-Prismatic Lead-Spar, or White and Black Lead-Spar
2. Rhomboidal Lead-Spar, or Green and Brown Lead-Spar.
3. Hemiprismatic Lead-Spar, or Red Lead-Spar.
4. Pyramidal Lead-Spar, or Yellow Lead-Spar.
5. Prismatic Lead-Spar, or Sulphate of Lead.
* 1. *Corneous Lead-Spar.*—2. *Arseniate of Lead.*—3. *Plomb Gomme.*

Order III.—Kerate.

Genus I. Corneous Silver.
1. Hexahedral Corneous Silver.

Genus II. Corneous Mercury.
1. Pyramidal Corneous Mercury.

Order IV.—Malachite.

Genus I. Copper Green.
1. Uncleavable Copper Green.

Genus II. Liriconite.
1. Prismatic Liriconite, or Lenticular Arseniate of Copper.
2. Hexahedral Liriconite, or Cubical Arseniate of Iron.

Genus III. Olivenite.
1. Prismatic Olivenite, or Prismatic Arseniate of Copper.
2. Di-Prismatic Olivenite.

Genus IV. Blue Malachite, or Blue Copper.
1. Prismatic Blue Malachite.
* *Velvet Blue Copper.*

Genus V. Emerald Malachite.
1. Rhomboidal Emerald Malachite.

Genus VI. Green Malachite.
1. Prismatic Green Malachite, or Phosphat of Copper.
2. Di-Prismatic Green Malachite, or Common Malachite.

* Atacamite.
1. Prismatic Atacamite, or Muriat of Copper

Order V.—Mica.

Genus I. Copper-Mica.
1. Rhomboidal Copper-Mica, or Micaceous Arseniate of Copper.
2. Prismatic Copper-Mica.

Genus II. Uran-Mica, or Uranite.
1. Pyramidal Uran-Mica.
* Uran-Ochre.

Genus III. Cobalt-Mica, or Red Cobalt.
1. Prismatic Red Cobalt.

* Cobalt-Ochre.
1. Black Cobalt-Ochre.

2. Brown Cobalt-Ochre.
3. Yellow Cobalt-Ochre.

Genus IV. Antimony-Mica, or White Antimony.
1. Prismatic White Antimony.
* Antimony Ochre.

Genus V. Blue Iron, or Iron-Mica.
1. Prismatic Blue Iron, or Phosphat of Iron.

Genus VI. Graphite.
1. Rhomboidal Graphite.

Genus VII. Talc-Mica.
1. Prismatic Talc-Mica, or Talc.
* 1. *Native Magnesia, or Hydrate of Magnesia.*—2. *Ophite.*—3. *Pikrolite.*—4. *Nephrite.*—5. *Steatite, or Soapstone.*—6. *Figurestone, or Algalmatolite.*—7. *Magnesite.*—8. *Meerschaum.*—9. *Lithomarge.*—10. *Mountain Soap.*—11. *Bole.*
2. Rhomboidal Talc-Mica, or Common Mica.
* Pinite.

Genus VIII. Pearl-Mica.
1. Rhomboidal Pearl-Mica.

Order VI.—Spar.

Genus I. Schiller-Spar.
1. Diatomous Schiller-Spar, or Common Schiller-Spar.
2. Axotomous Schiller-Spar, or Green Diallage.
3. Hemiprismatic Schiller-Spar, or Bronzite.
4. Prismatoidal Schiller-Spar, or Hypersthene.
5. Prismatic Schiller-Spar, or Anthophyllite.

Genus II. Kyanite.
1. Prismatic Kyanite.

Genus III. Spodumene.
1. Prismatic Spodumene.

Genus IV. Prehnite.
1. Axotomous Prehnite.
* *Karpholite.*

Genus V. Datolite.
1. Prismatic Datolite.

Genus VI. Zeolite.
1. Trapezoidal Zeolite, or Leucite.
2. Dodecahedral Zeolite, or Sodalite.
3. Hexahedral Zeolite, or Analcime.
4. Paratomous Zeolite, or Cross-stone.
5. Rhomboidal Zeolite, or Chabasite.
6. Diatomous Zeolite, or Laumonite.
7. Prismatic Zeolite, or Mesotype.
8. Prismatoidal Zeolite, or Stilbite.
9. Hemiprismatic Zeolite.
10. Pyramidal Zeolite, or Albine.
11. Axotomous Zeolite, or Apophyllite.

Genus VI. Petalite.
1. Prismatic Petalite.

Genus VII. Felspar.
1. Rhomboidal Felspar, or Nepheline.
2. Prismatic Felspar, or Common Felspar.
3. Pyramidal Felspar, or Scapolite, &c.
* *Elaolite.*

Genus VIII. Augite.
1. Paratomous Augite, or Common Augite, &c.
2. Hemiprismatic Augite, or Hornblende, &c.
3. Prismatoidal Augite, or Epidote.
4. Prismatic Augite, or Tabular Spar.

Genus IX. Azure-Spar.
1. Prismatic Azure-Spar, or Lazulite.
2. Prismatoidal Azure-Spar, or Blue Spar.
* 1. *Azure-Stone, or Lapis Lazuli.*—2. *Hauyne.*—3. *Calaite, or Mineral Turquois.*—4. *Amblygonite.*—5. *Diaspore.*—6. *Gehlenite.*

Order VII.—Gem.

Genus I. Andalusite.
1. Prismatic Andalusite.
* Fibrolite. ** Chiastolite.

Genus II. Corundum.
1. Dodecahedral Corundum, or Spinel.
2. Octahedral Corundum, or Automolite.
3. Rhomboidal Corundum, or Sapphire.
4. Prismatic Corundum, or Chrysoberyl.

Genus III. Diamond.
1. Octahedral Diamond.

Genus IV. Topaz.
1. Prismatic Topaz.

Genus V. Emerald.
1. Prismatic Emerald, or Euclase.
2. Rhomboidal Emerald.

Genus VI. Quartz.
1. Prismatic Quartz, or Iolite.
2. Rhomboidal Quartz.
3. Uncleavable Quartz.
4. Fusible Quartz.

Genus VII. Axinite.
1. Prismatic Axinite.

Genus VIII. Chrysolite.
1. Prismatic Chrysolite.

Genus IX. Boracite.
1. Octahedral Boracite.

Genus X. Tourmaline.
1. Rhomboidal Tourmaline.

Genus XI. Garnet.
1. Pyramidal Garnet, or Vesuvian.
2. Tetrahedral Garnet, or Helvine.
3. Dodecahedral Garnet.
4. Prismatic Garnet, or Cinnamon-Stone.
5. Prismatoidal Garnet, or Grenatite.
* *Aplome.* * *Eudialite.*

Genus XII. Zircon.
1. Pyramidal Zircon.

Genus XIII. Gadolinite.
1. Prismatic Gadolinite.

Order VIII.—Ore.

Genus I. Titanium-Ore.
1. Prismatic Titanium-Ore, or Sphene.
2. Peritomous Titanium-Ore, or Rutile.
3. Pyramidal Titanium-Ore, or Octahedrite.

Genus II. Zinc-Ore.
1. Prismatic Zinc-Ore, or Red Zinc-Ore.

Genus III. Red Copper-Ore.
1. Octahedral Red Copper-Ore.
Genus IV. Tin-Ore.
1. Pyramidal Tin-Ore.
Genus V. Wolfram-Ore.
1. Prismatic Wolfram.
Genus VI. Tantalum-Ore.
1. Prismatic Tantalum-Ore.
* Tantalite.
Genus VII. Uranium-Ore.
1. Uncleavable Uranium-Ore.
Genus VIII. Cerium-Ore.
1. Uncleavable Cerium-Ore.
* Allanite, or Prismatic Cerium-Ore.
** Cerin.
Genus IX. Chrome-Ore.
1. Prismatic Chrome-Ore, or Chromat of Iron.
Genus X. Iron-Ore.
1. Octahedral Iron-Ore, or Magnetic Iron-Ore.
* Titanitic Iron-Ore. ** Iserine.
*** Menachanite.
2. Rhomboidal Iron-Ore, or Red Iron-Ore.
3. Prismatic Iron-Ore, or Brown Iron-Ore.
* *Bog Iron-Ore.* ** *Lievrite.*
Genus XI. Manganese Ore.
1. Prismatic Manganese-Ore, or Black Manganese.
* Scaly Brown Manganese-Ore.
2. Prismatoidal Manganese-Ore, or Grey Manganese.
* 1. *Earthy Grey and Brown Manganese-Ore, or Wad.*—2. *Phosphat of Manganese.*

Order IX.—Native Metals.

Genus I. Arsenic.
1. Native Arsenic.
Genus II. Tellurium.
1. Native Tellurium.
Genus III. Antimony.
1. Dodecahedral Antimony.
2. Prismatic Antimony, or Antimonial Silver.
Genus IV. Bismuth.
1. Octahedral Bismuth.
Genus V. Mercury.
1. Liquid Native Mercury.
2. Dodecahedral Mercury, or Native Amalgam.
Genus VI. Silver.
1. Hexahedral Silver.
Genus VII. Gold.
1. Hexahedral Gold.
Genus VIII. Platina.
1. Native Platina.
Genus IX. Iron.
1. Octahedral Iron.
1. Subsp. Terrestrial Native Iron.
2. —— Meteoric Native Iron.
Genus X. Copper.
1. *Octahedral Copper.*
* 1. *Osmium.*—2. *Palladium.*—3. *Nickel.*

Order X.—Pyrites.

Genus I. Nickel Pyrites, or Copper-Nickel.
1. Prismatic Nickel Pyrites.
* *Nickel Ochre.*
** *Black Nickel.*
Genus II. Arsenic Pyrites.
* 1. Axotomous Arsenic Pyrites.
2. Prismatic Arsenic Pyrites.
Genus III. Cobalt Pyrites.
1. Hexahedral Cobalt-Pyrites, or Silver-White Cobalt.
2. Octahedral Cobalt-Pyrites, or Tin-White Cobalt.
* *Grey Cobalt Pyrites.*
** *Cobalt-Kies.*
*** *Radiated Tin-White Cobalt Pyrites.*
Genus IV. Iron Pyrites.
1. Hexahedral Iron-Pyrites.
2. Prismatic Iron-Pyrites.
3. Rhomboidal Iron-Pyrites, or Magnetic Pyrites.
Genus V. Copper-Pyrites.
1. Pyramidal Copper-Pyrites, or Yellow Copper-Pyrites.
Undetermined Pyrites.
* 1. *Nickeliferous Grey Antimony.*—2. *Common Tin Pyrites.*

Order XI.—Glance.

Genus I. Copper-Glance.
1. Tetrahedral Copper-Glance, or Grey and Black Copper.
2. Prismatoidal Copper-Glance.
3. Prismatic Copper Glance, or Vitreous Copper.
* 1. *Variegated Copper.*—2. *Argentiferous Copper-Glance.*—3. *Plumbiferous Copper-Glance*—4. *Tennantite.*—5. *Eukairite.*
Genus II. Silver-Glance, or Vitreous Silver.
1. Hexahedral Silver-Glance.
Genus III. Galena, or Lead-Glance.
1. Hexahedral Galena, or Lead-Glance.
* *Blue Lead.*
Genus IV. Tellurium Glance, or Black Tellurium.
1. Prismatic Tellurium Glance.
Genus V. Molybdena, or Molybdena Glance.
1. Rhomboidal Molybdena.
* *Molybdena Ochre.*
Genus VI. Bismuth Glance.
1. Prismatic Bismuth-Glance.
* Bismuth Ochre.
** *Acicular Bismuth-Glance, or Needle Ore.*
Genus VII. Antimony-Glance.
1. Prismatic Antimony-Glance.
2. Prismatoidal Antimony-Glance,* or Grey Antimony.
3. Axotomous Antimony-Glance, or Bournonite.

Genus VIII. Melane Glance.

1. Diprismatic Melane-Glance, Black Antimony-Ore of Werner.
2. Prismatic Melane-Glance, Brittle Silver-Glance of Werner.

Order XII.—Blende.

Genus I. Manganese-Blende.

1. Prismatic Manganese-Blende.

Genus II. Zinc-Blende, or Garnet-Blende.

1. Dodecahedral Zinc-Blende.

Genus III. Antimony-Blende, or Red Antimony.

1. Prismatic Antimony-Blende, or Red Antimony.

Genus IV. Ruby Blende.

1. Rhomboidal Ruby-Blende, or Red Silver.
2. Peritomous Ruby-Blende, or Cinnabar.

Order XIII.—Sulphur.

Genus I. Sulphur.

1. Prismatoidal Sulphur, or Yellow Orpiment.
2. Hemi-Prismatic Sulphur, or Red Orpiment.
3. Prismatic Sulphur, or Common Sulphur.

CLASS III.

Order I.—Resin.

Genus I. Mellilite, or Honey-Stone.

1. Pyramidal Mellilite, or Honey-Stone.

Genus II. Mineral Resin.

1. Yellow Mineral Resin, or Amber.
2. Fossil Copal.
3. Black Mineral Resin.
4. Retinite.
5. Dysodilite.

Order II.—Coal.

Genus I. Mineral Coal.

1. Bituminous Mineral-Coal.
2. Glance-Coal.

APPENDIX.

Minerals Imperfectly Known.

1. Allophane.—2. Bismuthic Silver.—3. Bloedite.—4. Fluat of Cerium.—5. Conite.—6. Cronstedtite.—7. Couzeranite.—8. Gieseckite.—9. Gismondite.—10. Hisengerite.—11. Humite.—12. Ligurite.—13. Mellilite.—14. Molybdenic Silver.—15. Orthite.—16. Polyhalite.—17. Pyrallolite.—18. Pyrorthite.—19. Pyrosmalite.—20. Sapparite.—21. Skorodite.—22. Spinellane.—23. Stilpnosiderite.—24. Sordawalite.—25. Wavellite.—26. Yttrocerite.—27. Zurlite.

Mode of determining a Mineral, or of referring it to its place in the System.

The characters principally employed in the formation of what is called the *Specific Character* are the regular crystallizations (including cleavage); the degrees of hardness; and the specific gravity. The first character then given in the *Specific Character* is the system of crystallization to which the form and cleavage of the species belongs. Then follows, together with its dimensions (if known), the fundamental form, from which all other simple and compound forms are derived. In rhomboids, that edge which ends in the apex of the axis, that is to say, the terminal edge is given; for instance, in calcareous spar, R$=105°5'$; in isosceles four-sided pyramids, both edges, first the terminal one, and then that on the base, are mentioned; for instance, in pyramidal zircon, P$=123°19'$, $84°20'$; and in scalene four-sided pyramids, first, both of the terminal edges, and then that at the basis, are given: thus, in prismatic topaz, P$=141°7'$, $101°52'$, $90°55'$. In this system, besides the dimension of the finite forms, those of the infinite ones, or of the limits, are mentioned, as in the last example, $P+\infty=124°19'$, and so on; which is very convenient, as the cases in which these can be examined occur more frequently than those in which the edges of pyramids can be measured.

After this follows the indication of the general aspect of the combinations, explained in the foregoing §§ 63–67, under the denominations of dirhomboidal, hemi-prismatic, &c. Of the former are mentioned the angles at the edges of combination, of the latter that terminal edge, which is formed by the intersection of the remaining faces of the scalene four-sided pyramid.

With respect to cleavage, the expression "cleavage, R," for instance in rhomboidal calcareous spar, means, that this mineral has its cleavage parallel to the faces of a rhomboid, similar to the fundamental form of the species; "cleavage $P-\infty$. $P+\infty$. $[P+\infty]$" in pyramidal garnet means that this mineral has its cleavage parallel to the faces of two rectangular prisms, and at the same time perpendicular to their axis; "cleavage $\breve{P}r+\infty$" in prismatic chrysolite, indicates that the cleavage of this mineral passes at the same time through the axis and the short diagonal of the prism $P+\infty$; and "cleavage $(\breve{P}r+\infty)^3=87°42'$. $\breve{P}r+\infty$. $\bar{P}r+\infty$," expresses, for instance, in paratomous augite, that the individuals of this species can be cleaved, first parallel to the faces of an obliquangular four-sided prism, of the given dimensions; and, secondly, parallel to planes, which pass through the axis and both diagonals of the prism $P+\infty$; or, what comes to the same, parallel to the faces of a rectangular prism.

Characters mutually excluding each other.

If two or more characters, the one of which excludes the other, be coexistent in the character of an order, or of a genus, as in the genus Corundum, "Tessular, rhomboidal, prismatic," the meaning is, that an individual belonging to this genus must be either tessular, or rhomboidal, or prismatic; because only one of these three can take place at the same time. In the specific character this never happens, because all the forms must belong to one system.

Determination of a Mineral in general.

If a mineral is to be determined, first its *form* must be made out, at least so far as to know the system to which it belongs. Then *hardness* and *specific gravity* must be tried with proper accuracy, and expressed in numbers. It is sufficient, however, to know the latter to one or two decimals. The specific character requires these data; and they are also of use in the characters of the genera, orders, and classes. This being done, the system may be consulted, and this will at the same time point out what other characters are wanting; so that a mere inspection of the mineral, or a very easy experiment, for instance, to try the streak upon a file, or, still better, upon a plate of porcelain biscuit, will be sufficient. Having advanced in this manner to the character of the species, it will, in some instances, be necessary, and in all cases advisable, for the sake of certainty, to have recourse to the dimensions of the forms. This is particularly necessary, if the genus to which the mineral belongs contains several species having forms of the same system, as is the case in the genus Augite. This determination of the dimensions of the forms may be effected by the common goniometer, the differences in the angles being in general so great, that they cannot easily be missed, even by the application of this instrument.

It will seldom be necessary to read over the whole of any character of a class, order, genus, or species, excepting those which comprise the individual; one character that does not agree sufficing for its exclusion. Thus even the characters of the orders, though the longest, will not be found troublesome.

The application of the method will become very easy and expeditious, by taking particular notice of some characters, which may be termed *prominent*. Such are a metallic aspect; a high degree of specific gravity (particularly if the mineral is not metallic), and a high degree of hardness. The observation of these will immediately decide whether an individual can belong to any particular class, order, genus, or species. It is understood, that if it be not thereby excluded, the other characters must next be examined, till either an excluding one be found, or, if not, the individual may be considered as belonging to that class, order, &c. with which it has been compared and found to agree.

Example.—In illustration of this, let us take the following example: Let the form of an unknown mineral be a combination of a scalene eight-sided pyramid, of an isosceles four-sided pyramid, and of a rectangular four-sided prism; the cleavage parallel to the faces of two rectangular four-sided prisms, in a diagonal position to each other; form and cleavage, therefore, *pyramidal*, or belonging to the pyramidal system. Let *hardness* be $=6.5$; *specific gravity* $=6.9$.

In this case, both hardness and specific gravity are prominent characters, and exclude at once the individual from the first and third, but not from the second class; with the characters of which its other properties also perfectly agree. Hence the individual belongs to the second class.

Comparing the properties of the individual with the characters of the orders in the second class, hardness and specific gravity will be found too great for the order Haloïde; hardness too great for the orders Baryte and Kerate; both of them too great for the orders Malachite and Mica; and specific gravity too great for the orders Spar and Gem. But in the character of the order ore, both hardness and specific gravity fall between the fixed limits, and cannot exclude the individual from this order. The other parts of this character are now to be taken in consideration. If the lustre of the individual be metallic, its colour must be black, otherwise it cannot belong to the order ore. But the lustre is not metallic; therefore the colour of the individual is of no consequence; that is, this conditional part of the character does not affect the individual, and consequently cannot determine its place. Since the lustre is not metallic, the individual must exhibit adamantine, or imperfect metallic lustre; the first will be found particularly in the fracture. The next part of the character refers to minerals of a red, yellow, brown, or black streak; and as the individual gives none of these, its streak being white, this part of the character does not come into consideration. Hardness keeps between the limits, as stated in the character of the order ore. Should it be $=4.5$ and less, the streak must be yellow, red, or black; but hardness is $=6.5$, therefore the colour of the streak is indifferent. If the hardness be $=6.5$ and more, and streak white, then the specific gravity must be $=6.5$ and more. Now, this condition takes place: hardness is $=6.5$, and the streak is white; the specific gravity being $=6.9$, which is greater than 6.5. Lastly, the specific gravity keeps within the limits.

As far as respects the individual which is to be determined, all the characters in the characteristic of the order ore may be divided into two parts. The first part contains those which refer to the individual; the second those which do not; the last afford no decisive distinctions. But with the first all the properties of the mineral agree. These properties agree consequently with the whole character of the order, as far as it is applicable to the individual, and determine it to belong to the order ore; or, in shorter terms, to be an *ore*.

Beginners may also compare the characters of the remaining orders. Sometimes they find one individual belonging to two orders, in which case there must be evidently a mistake in the comparison, which would perhaps not have been discovered, had they stopt at the first order, which does not exclude it. In the present case, the want of metallic lustre excludes the individual from the orders, metal, pyrites, and glance; hardness from the order blende; and both hardness and specific gravity from the order sulphur. The individual can, therefore, be nothing else than an ore; and the characters of the genera of the order Ore may now be examined.

If we consider again hardness and specific gravity as prominent, the individual will be immediately excluded from the genera titanium-ore, zinc-ore, and copper-ore, but not from the genus tin-ore. The form of the pyramidal system, and the white streak, show that it belongs to this genus. From the genus scheelium-ore, it is excluded by its

too great hardness, and too low specific gravity. From the genera tantalum, uranium, cerium, chrome, iron, and manganese-ore, by hardness and specific gravity, both of them being too high; as also by its white streak, which only agrees with that genus from which the individual differs most by its hardness and specific gravity. The form also does not agree with any in these genera, consequently the individual can belong to no other than to the genus *tin-ore*.

This genus contains but one species. The conclusion that the individual must belong to this species might, nevertheless, be erroneous. There could exist a second species of this genus. The dimensions of the form must now be accurately considered. If these coincide with the angles given in the character, the highest degree of certainty that the individual belongs to or is pyramidal tin-ore, will be obtained.

Perfect determination supposes all the Characters to be known.

The perfect determination of an individual depends, as the above example has shown, upon the possibility of making out correctly those three properties, viz. form, including cleavage, hardness, and specific gravity. In botany it is the same. The characters must be observable, otherwise the determination will be impossible. In mineralogy, the method affords sometimes more: it leads to a correct determination, even if the knowledge of the form remains imperfect. But it will be an useful rule for beginners to occupy themselves at first with the determination of such individuals as present properties which can be easily and fully investigated. The rest will come of itself, when their knowledge of the mineral kingdom, and particularly of the properties of minerals, increases, and when they have by experience acquired the skill to judge properly of form and cleavage, at least, so far as is necessary for the determination of the system of crystallization, even in those cases where form and cleavage are somewhat difficult to be observed. This exercise is recommendable to every naturalist who intends to acquire a satisfactory knowledge of minerals, by means of the present method.

Immediate and Mediate Determination.

The method of determination, illustrated by an example at page 432, is termed the *immediate* determination, because it is applied immediately to the individual which is to be determined. The contrary of this is the *mediate* determination, so called on account of its mediate application to the given individual. That variety of hemiprismatic augite, which is known by the name *amianthus*, occurs in crystals so very seldom, as to withdraw their form, supposing it to be regular, from the sight, aided even by the most powerful magnifying instruments; cleavage is evidently still less observable. These crystals are flexible like fibres of flax; their hardness, therefore, cannot be estimated. Their surface has so great an extent in respect to their bulk, that they will swim in water, though endowed with a pretty considerable specific gravity, which, therefore, cannot be ascertained. Some varieties, however, may be observed, whose crystals are a little thicker, though, in other respects, these varieties perfectly agree with amianthus. These varieties lose their flexibility, yet they are too frangible to be able to sustain the trial of hardness. Others are still thicker, but the dimensions of their forms cannot be ascertained on account of their minuteness. They sink in water, and scratch prismatoidal gypsum, but they break, if tried upon calcareous spar. By thus proceeding, we come to such varieties, as possessing a discernible form, allow the cleavage to be investigated; we find their specific gravity about three times that of the water, and their hardness between five and six. These will be immediately determinable, and be found to belong to the species of hemiprismatic augite. Chalk, rock-milk, clay-slate, and a great many other minerals not allowing of an immediate determination, are determined in the same way, and thus nothing escapes in the natural history method, which in any one of the other methods can be an object of determination.—*Vide Edinburgh Philosophical Journal*, for fuller details in regard to the determination of species, and also for a series of observations on the principles of the Natural History method.

NATURAL HISTORY OF SIMPLE MINERALS.

CLASS I.

Specific gravity under 3.8. If solid, is sapid. No bituminous smell.

Order I.—GAS.

Sp. gr. =0.0001,—0.00014. Elastic. Not acid.

Genus I.—HYDROGEN GAS.

Evident smell. Sp. gr. =0.0001,—0.00014.

1. *Pure Hydrogen Gas.*

Specific Character.—Hydrogenous smell. Sp. gr. =0.00012.

Geognostic and Geographic Situations.—Emanates from rocks of limestone, and of the coal formation, not only in Europe, but in other quarters of the globe.

2. *Empyreumatic or Carburetted Hydrogen Gas.*

Specific Character.—Empyreumatic smell. Sp. gr. =0.0008.

Geognostic and Geographic Situations.—Rises from marshes in different parts of Great Britain, and from marshes and volcanoes in other countries.

3. *Sulphuretted Hydrogen Gas.*

Specific Character.—Smell of putrid eggs. Taste nauseous and bitter. Sp. gr. =0.00135.

Geognostic and Geographic Situations.—Rises from marshes, sulphureous springs, and volcanoes. It is met with in many places in Great Britain.

4. *Phosphuretted Hydrogen Gas.*

Specific Character.—Smell of putrid fish. Sp. gr. unknown.

Geognostic and Geographic Situations.—It rises from marshy places, where organic substances are in a state of decomposition.

Genus II.—Atmospheric Air.

Without smell or taste. Sp. gr. =0.001, -0.0015.

1. *Pure Atmospheric Air.*

Specific Character.—Without smell or taste.

Forms the atmosphere which surrounds the earth.

Order II.—Water.

Liquid. Tasteless, or with sensible taste and smell. Sp. gr. =1.1,—1.0269.

Genus I.—Atmospheric Water.

Without smell or taste.

1. *Pure Atmospheric Water.*

Specific Character.—Without smell or taste.

This is common rain, river, and spring water. Mineral waters might be introduced into this part of the system.

Genus II.—Sea Water.

Sensible smell and taste.

1. *Common Sea Water.*

Specific Character.—Bitter nauseous taste, and disagreeable smell.

Is the water of the ocean.

Order III.—Acid.

Sp. gr. =0.0045,—3.7. Acid.

Genus I.—Carbonic Acid.

Taste slightly acid. Sp. gr. =0.0018.

1. *Aeriform Carbonic Acid.*

Specific Character.—Elastic. Taste acidulous and pungent.

Geognostic and Geographic Situations.—Occurs in marshy places and in acidulous waters, in Great Britain and other countries.

Genus II.—Muriatic Acid.

Smell of saffron, and strong acid taste. Sp. gr. =0.0023.

1. *Aeriform Muriatic Acid.*

Specific Character.—Elastic. Smell pungent and suffocating.

Geognostic Situation.—Rises from volcanoes.

Genus III.—Sulphuric Acid.

If gaseous, the smell is sulphureous. If liquid, the taste is strongly acid. Sp. gr. =0.0025,—1.5.

1. *Aeriform Sulphuric Acid.*

Specific Character.—Elastic. Sp. gr. =0.0028.

Geognostic Situation.—Often rises in considerable quantities from volcanoes.

2. *Liquid Sulphuric Acid.*

Specific Character.—Liquid. Sp. gr. =1.4,—1.5.

Geognostic Situation.—Occurs in volcanic districts in Italy, America, and Java.

Genus IV.—Boracid Acid.

Solid. Sp. gr. under 3.0.

1. *Prismatic Boracic Acid.*

Specific Character.—Prismatic. Pyramid unknown. Occurs in scaly crusts. Taste first sourish, or sub-acid, then bitter and cooling, and lastly, sweetish.

Geognostic and Geographic Situations.—Found on the edges of hot springs in Italy, &c.

Genus V.—Arsenic Acid.

Solid. Sp. gr. above 3.0.

1. *Octahedral Arsenic Acid.*

Arsenic oxyde.—*Haüy.*

Specific Character.—Tessular. Cleavage, octahedral. Taste sweetish-astringent. Hardness unknown. Sp. gr. =3.6,—3.7.

Description.—Colour white. Occurs in delicate capillary crystals; also massive, in crusts, stalactitic, reniform and betryodal. Translucent or opaque.

Geognostic and Geographic Situations.—Occurs in veins at Andreasberg in the Hartz.

Order IV.—Salt.

Sp. gr. =1.2,—2.9. Solid. Not acid.

Genus I.—Natron.

Prismatic. Taste, pungent and alkaline. Hardness, =1.0, —1.5. Sp. gr. =1.5, —1.6.

1. *Prismatic Natron.*—Jameson.

Prismatishes Natron-Salz, *Mohs.*—Natürliches Mineral-Alkali, *Werner.*—Soudé carbonatée, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, hemi-prismatic. Cleavage prismatic.

Description.—Its chief colours are grey, white, and yellow. Occurs in acecular crystals, in radiated and granular distinct concretions; also in loose earthy particles, and in crusts. Is more or less translucent.

Geognostic and Geographic Situations.—Occurs in crusts on rocks and soils of different kinds; and also in the waters of natron lakes and springs. It is particularly abundant in the natron lakes in Egypt.

Genus II.—Glauber Salt.

Prismatic. Taste, first cooling, then saline and bitter. Hardness, =1.5, —2.0. Sp. gr. 1.4, —1.5.

1. *Prismatic Glauber Salt.*—Jameson.

Prismatisches Glauber Salz, *Mohs.*—Natürliches Glauber Salz, *Werner.* Soude sulphatée, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, hemi-prismatic. $\frac{\breve{P}}{2}$. Cleavage, $\breve{P}r+\infty$ perfect. Less perfect, $\bar{P}r+\infty$. (Fig. 29, 28.)

Description.—Colour white, sometimes inclining to yellow. Occurs in acicular crystals, granular con-

cretions, stalactitic, in loose earthy particles, and in crusts. More or less translucent.

Geognostic and Geographic Situations.—Occurs on soils and rocks of different descriptions, in Scotland, England, and other countries.

Genus III.—Nitre.

Prismatic. Taste, cooling and saline. Hardness, =2.0. Sp. gr. 1.9, —2.0.

1. *Prismatic Nitre.*—Jameson.

Prismatiches Nitrum-Salz, *Mohs.*— Natürlicher Salpeter, *Werner.*—Potasse nitratée, *Haüy.*

Specific Character.—Prismatic. Pyramid =132° 22′; 91° 15′; 107° 43′. Cleavage, $P+\infty$ =120°. More distinct, $\breve{P}r+\infty$. (Fig. 30, 29.)

Description.—Colour white, grey, and sometimes yellow. Occurs in acicular crystals, in crusts, and in fibrous concretions. More or less translucent.

Geognostic and Geographic Situations.—Occurs incrusting limestone, marl, sandstone, calc-tuff, chalk, and on soils of particular kinds; also incrusting the walls of limestone caves. Occurs in considerable abundance in limestone caves in Italy, in caves of various descriptions in America, and in abundance on the surface of the ground in many of the Tartarian plains.

Genus IV.—Rock-Salt.

Tessular. Taste, saline. Hardness =2.0. Sp. gr. =2.2, —2.3.

1. *Hexahedral Rock-Salt.*—Jameson.

Hexædrisches Steinsalz, *Mohs.*

Specific Character.—Tessular. Cleavage, hexahedral.

Description.—Most frequent colours grey and white; sometimes also blue, red, yellow, and green. Occurs in granular, fibrous, radiated, and prismatic concretions; massive, dentiform, and stalactitic. Lustre between vitreous and resinous. More or less transparent and translucent.

Geognostic and Geographic Situations.—It occurs in beds, imbedded masses, and veins, associated with saliniferous clay, gypsum, limestone, sandstone, and anhydrite, in the *salt formation;* also, in layers and crusts on soils of particular kinds, and deposited on the shores of salt lakes, and in the vicinity of salt springs. Occurs abundantly in Cheshire, and also in other parts of England.

Genus V.—Sal Ammoniac.

Tessular. Taste, pungent and urinous. Hardness =1.5, —2.0. Sp. gr. 1.5, —1.6.

1. *Octahedral Sal Ammoniac.*—Jameson.

Octaedrisches Salmiac, *Mohs.* Natürlicher Salmiac, *Werner.* Ammoniaque Muriatée, *Haüy.*

Specific Character.—Tessular. Cleavage, octahedral.

Description.—Colours white, grey, yellow, and sometimes green and bluish. Occurs in granular and fibrous concretions; also in efflorescences, in crusts, stalactitic, botryoidal, tuberose, and corroded. More or less translucent.

Geognostic and Geographic Situations.—Occurs in crusts in the fissures and on the surfaces of volcanic rocks, as in Vesuvius, Ætna, &c.

Genus VI.—Vitriol.

Pyramidal, prismatic. Taste, astringent. Hardness =2.0, —2.5. Sp. gr. =1.9, —2.3.

1. *Hemi-prismatic Vitriol, or Green Vitriol.*—Jameson.

Hemiprismatisches Vitriol-Salz, *Mohs.* Eisen Vitriol, *Werner.* Fer Sulfatée, *Haüy.*

Specific Character.—Prismatic. Pyramid =161° 15′; 82° 20′; 103° 35′, $P+\infty$ =24° 25′. Combination, hemi-prismatic $\frac{P}{2}$ = 82° 26′. Cleavage, $\frac{\breve{I}}{2}$. More perfect, $\breve{P}r+\infty$. (Fig. 40.) The inclination of $\frac{\breve{P}}{2}$ to $\frac{\breve{P}r}{2}+\infty$ = 80° 37′. Green. Hardness, = 2.0. Sp. gr. =1.9, —2.0.

Description.—Colour green. Occurs regularly crystallized, in fibrous concretions, massive, stalactitic, botryoidal, and reniform. More or less translucent and transparent.

Geognostic and Geographic Situations.—Occurs in coal and iron mines, both in Scotland and England.

2. *Prismatic Vitriol, or Blue Vitriol.*—Jameson.

Prismatisches Vitriol-Salz, *Mohs.* Kupfervitriol *Werner.* Cuivre Sulfatée, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, tetartoprismatic. Cleavage, two faces, one more distinct than the other; incidence, 124° 2′. Hardness =2.5. Sp. gr. =2.2, —2.3.

Description.—Colour blue. Occurs distinctly crystallized, massive, stalactitic, and dentiform More or less transparent and translucent.

Geognostic and Geographic Situations.— Occurs in copper mines in England and Ireland.

3. *Pyramidal Vitriol, or White Vitriol.*—Jameson.

Pyramidales Vitriol-Salz, *Mohs.*—Zink-vitriol. *Werner.*—Zinc sulfatée, *Haüy.*

Specific Character.—Pyramidal. Pyramid=120°; 90°. Cleavage unknown, and imperfect. White. Hardness unknown. Sp. gr. =2.0.

Geognostic and Geographic Situations.—Occurs in mines where blende is met with, both in Flintshire and Cornwall.

Genus VII.—Epsom Salt.

Prismatic. Taste bitter and saline. Hardness unknown. Sp. gr. unknown.

1. *Prismatic Epsom Salt.*—Jameson.

Bittersalz, *Mohs.*—Naturlicher Bittersalz, *Werner* —Magnesie Sulfatée, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage very imperfect prismatoidal.

Description.—Colours white and grey. Occurs in crusts, botryoidal, reniform, and crystallized,—varies from transparent to translucent.

Geognostic and Geographic Situations.—Occurs along with natural alum at Hurlet near Paisley.

Genus VIII.—Alum.

Tessular. Taste sweetish, astringent, and acidulous. Hardness =2.0,—2.5. Sp. gr.=1.7,—1.8.

1. *Octahedral Alum.*—Jameson.

Octaedrisches Alaun, *Mohs.*—Natürlicher Alaun, *Werner.*

Specific Character.—Tessular. Cleavage octahedral.

Description.—Colours white. Occurs in farinaceous efflorescences, stalactitic, and in fibrous concretions,—more or less translucent.

Geognostic and Geographic Situations.—Generally occurs incrusting aluminous minerals, and in this situation it is met with in various parts of Scotland and England.

Genus IX.—Borax.

Borax-Salz, *Mohs.*

Prismatic. Taste feebly sweetish and alkaline. Hardness =2.0,—2.5. Sp. gr.=1.5,—1.7.

1. *Prismatic Borax.*—Jameson.

Prismatisches Borax-Salz, *Mohs.*—Soude Boratée, *Haüy.*

Specific Character.—Prismatic. $P=152^{0}\ 9'$; $120^{0}\ 28'$; $67^{0}\ 3'$. $P+\infty=52^{0}\ 53'$. Combination, hemiprismatic, $\frac{P}{2}=120^{\circ}\ 23'$. Cleavage $(Pr+\infty)^{3}=88^{0}\ 9'$. More distinct $\breve{P}r+\infty$. (Fig. 32, 29.)

Description.—Colours white, grey, and green. Occurs crystallized, internally shining and resinous. Fracture, flat, conchoidal. Semitransparent.

Geognostic and Geographic Situations.—Occurs in the soil, and in the water of springs, in Thibet and Persia.

Genus X.—Glauberite.

Brithyn-Salz, *Mohs.*

Prismatic. Taste feebly saline and astringent. Hardness =2.5,—3.0. Sp. gr.=2.7,—2.9.

1. *Prismatic Glauberite.*—Jameson.

Prismatisches Brithyn-Salz, *Mohs.*—Glauberite, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination hemiprismatic. Cleavage $\frac{\bar{P}r}{2}$, perfect. Indistinct $P+\infty=104^{\circ}\ 28'$. (Fig. 35, 30.)

Description.—Colours white and yellow. Occurs crystallized in oblique four-sided prisms. Shining lustre. Fracture conchoidal. Transparent. Brittle.

Geognostic and Geographic Situations.—Occurs in masses of rock-salt, associated with clay, at Villarubia near Ocanas, in the province of Toledo, in Spain.

CLASS II.

Specific gravity above 1.8. Insipid.

Order I.—Haloide. *

No metallic lustre. Streak white or grey. Hardness =1.5.—5.0. Sp. gr.=2.2.—3.3.

If pyramidal, or prismatic, the hardness =4.0, and less. If tessular, the hardness =4.0. If single highly perfect faces of cleavage, the Sp. gr.=2.4, and less. If the hardness is under 2.5, the Sp. gr.=2.4, and less. If the Sp. gr.=2.4, and less, the hardness is under 2.5, and no resinous lustre.

Genus I.—Gypsum.

Prismatic. Hardness =1.5,—3.5. Sp. gr.=2.2—3.0.

If the Sp. gr. is above 2.5, there are cleavages in three directions, perpendicular to each other, and two are more distinct than the others.

1. *Prismatoidal Gypsum*, or *Common Gypsum.*—Jameson.

Prismatoidisches Gyps-Haloid, *Mohs.*—Chaux sulfatée, *Haüy.*

Specific Character.—Prismatic. Pyramid$=149^{\circ}\ 33'$; $135^{\circ}\ 32'$; $54^{\circ}\ 52'$. $P+\infty=110^{\circ}\ 30'$. Combination. Hemiprismatic, $\frac{P}{2}=149^{\circ}\ 33'$. Cleavage, $\breve{P}r+\infty$, very perfect and distinct, $\frac{\bar{P}r}{2}$. $Pr+\infty$. (inclination to each other, $=113^{\circ}\ 6'$) (Fig. 41.) Hardness =1.5.—2.0. Sp. gr.=2.2.—2.4.

Description.—Most frequent colours white and grey; occurs also yellow, red, blue, green, brown, and even black. Occurs in regular crystals; in granular, scaly-granular, and fibrous distinct concretions; massive, disseminated, and dentiform. Lustre alternates from splendent to glimmering, and is pearly. Fracture splintery. Fragments indeterminate angular and blunt-edged. Alternates from transparent to translucent on the edges.

The transparent and highly crystallized varieties are named *selenite;* those in granular concretions, *foliated granular gypsum;* those disposed in fibrous concretion, *fibrous gypsum;* the splintery fracture characterizes the *compact gypsum;* while those varieties composed of scaly-granular concretions form the subspecies named *scaly-foliated gypsum.* Some varieties, composed of fine scaly or dusty and slightly cohering particles, are named *earthy gypsum.*

Geognostic and Geographic Situations.—*Selenite*, the purest subspecies, occurs most frequently in what are called the gypsum and salt formations of the secondary class of rocks; also in metalliferous veins of different descriptions, and in various alluvial clays and marls. The *foliated granular* subspecies occurs in beds, in transition, and secondary rocks,—being in the former intermixed with mica, in the latter with quartz, boracite, &c. The *compact variety*

* From ἅλς, salt; and εἶδος, the appearance (habitus).

occurs in considerable abundance along with the granular in the secondary gypsum formation, and the *fibrous* is disposed in veins, in the same formation, which also contains the *scaly foliated* and the *earthy kinds*.

The salt mines in England afford examples of nearly all the subspecies, and several of them are also met with in Scotland.

2. *Prismatic Gypsum, or Anhydrite.*—Jameson.

Prismatisches Gyps-Haloide, *Mohs*.—Muriacit, *Werner*.—Chaux Anhydro-Sulphatée, *Haüy*.

Specific Character.—Prismatic, Pyramid $=121°$ $32'$; $108°35'$; $99°7'$. Cleavage, $\breve{P}r-\infty$. $\bar{P}r+\infty$. Less perfect $P-\infty$. Traces of $P+\infty=100°8'$. (Fig. 29, 28, 27,30.) Hardness $=3.0,-3.5$. Sp. gr. $=2.7,-3.0$.

Description.—Colours white, blue, red, and grey. Occurs crystallized; in granular, fibrous, and lamellar concretions; massive, and vermicularly convoluted or contorted. Lustre alternates from splendent to glistning, and is pearly. Fracture splintery and conchoidal. Alternates from transparent to translucent on the edges.

Geognostic and Geographic Situations.—Occurs massive, and in beds in the salt and secondary gypsum formations. Is frequently intermixed with rock salt, also with stinkstone, saliniferous clay, and occasionally with ores of different kinds. Some varieties are met with in transition and primitive rocks. Several of the varieties are found in the red sandstones of England and Scotland.

Genus II.—Cryolite.

Prismatic. Cleavage in three directions, perpendicular to each other, of which one is more perfect than the others. Hardness $=2.5,-3.0$. Sp. gr. $=2.9,-3.0$.

1. *Prismatic Cryolite.*—Jameson.

Kryolite, *Werner*.—Prismatisches Kryon-Haloide, *Mohs*.—Alumine fluatée alcaline, *Haüy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P-\infty$. Less distinct, $\breve{P}r+\infty$. $\bar{P}r+\infty$. Traces of P. (Fig. 27, 29, 28.)

Description.—Colours white, brown, and red. Occurs massive, disseminated, and in lamellar concretions. Internally shining, and lustre vitreous, inclining to pearly. Fracture uneven. Fragments cubical. Translucent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—It has hitherto been found only in West Greenland, where it occurs in gneiss, and associated with iron pyrites and galena or lead-glance.

Genus III.—Alumstone.

Alaun Haloide, *Mohs*.—Alaunstein, *Werner*.

Rhomboidal. Hardness $=5.0$. Sp. gr. $=2.4,-2.6$.

1. *Rhomboidal Alumstone.*—Jameson.

Rhomboidrisches Alaun Haloide, *Mohs*.

Specific Character.— Rhomboidal. Rhomboid unknown. Cleavage $R-\infty$. R.

Description.—Colours white, red, and rarely grey. Occurs massive, porous, and vesicular Lustre feebly glimmering. Fracture uneven. Feebly translucent on the edges. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in beds and large irregular masses in porphyry in Hungary, and in veins and drusy cavities in aluminous rocks at Tolfa, near to Civita Vecchia.

Genus IV.—Fluor.

Tessular. Hardness $=4.0$. Sp. gr. $=3.0,-3.3$.

1. *Octahedral Fluor.*—Jameson.

Octaedrisches Flus Haloide, *Mohs*.—Chaux fluatée, *Haüy*.

Specific Character.—Tessular. Cleavage Octahedral.

Description.—Colours white, grey, black, blue, green, yellow, red, and brown. Occurs regularly crystallized, in granular, prismatic, and lamellar concretions, massive, and disseminated. Lustre from splendent to feebly glimmering, and vitreous. Fracture even, inclining to splintery and to conchoidal. More or less transparent and translucent. Brittle, land easily frangible.

The varieties, with even fracture and feeble lustre, are named *compact fluor;* those in which the cleavage is distinct are named common or *foliated fluor;* and some rare, dull, earthy, and loosely aggregated varieties, which occur, incrusting other minerals, are described under the name *earthy fluor*.

Geognostic and Geographic Situations.—It occurs in veins and beds in primitive gneiss, mica slate, and clay slate, in various remarkable metalliferous formations of cobalt, silver, tin, lead, copper, &c.; less frequently in transition rocks, and very abundantly in some secondary rocks, as limestone, and rarely in secondary porphyries. It is a rare mineral in Scotland, its principal localities being Monaltree, in Aberdeenshire, Banffshire, Papa Stour, in Shetland, and Gourock, in Renfrewshire. It is very abundant in several of the mining districts in England.

Genus V.—Apatite.

Rhomboidal. Hardness $=5.0$. Sp. gr. $=3.0$, 3.3

1. *Rhomboidal Apatite.*

Rhomboedrisches Flus-haloide, *Mohs*.—Apatit, *Werner*.—Chaux phosphatée, *Haüy*.

Specific Character.—Rhomboidal. $R=88°51'$. Combination, di-rhomboidal. $2(R)=131°11'$, $111°20'$, $(P+n)^m$ hemi-dirhomboidal, with parallel planes. Cleavage, $R-\infty$. $P+\infty$. $H=5$. Sp. gr. $=3.0-3.3$.

Description.—Colours white, green, blue, red, yellow, and brown. Occurs regularly crystallized; in concretions which are granular, lamellar, and fibrous; massive and disseminated; lustre resinous, and varying from splendent to glimmering. Fracture conchoidal and uneven. Alternates from transparent to feebly translucent on the edges. Brittle, and easily frangible.

One set of varieties, in which the cleavage is very distinct, is named *foliated apatite;* another, in which

the fracture is conchoidal, is named *conchoidal apatite*; and the varieties in which the fracture is uneven are named *phosphorite*.

Geognostic and Geographic Situations.—Occurs in gneiss, near Kincardine, in Ross-shire; in the same rock in the Shetland Islands; and in veins in greenstone, in the Island of Rume. Several varieties are met with in Cornwall.

Genus VI.—Limestone.

Kalk-Haloide.—*Mohs.*

Rhomboidal, prismatic. Cleavage, rhomboido-paratomous, prismatoidal. Hardness $=3.0$, -4.5. Sp. gr. $=2.5$, -3.2. If the hardness is above 4.0, the specific gravity $=2.8$ and more.

1. *Prismatic Limestone*, or *Arragonite.*—Jameson.

Prismatisches Kalk-Haloide, *Mohs*.—Arragon, *Werner.*

Specific Character.—Prismatic. Pyramid $=113^\circ 44'$; $93^\circ 13'$; $122^\circ 10'$. $P+\infty=105^\circ 23'$. Cleavage, $\bar{P}r-1=109^\circ 28'$. $(\breve{P}r+\infty)^3=64^\circ 4'$. More distinct $\bar{P}r+\infty$. Fig. 42. Hardness $=3.5$, -4.0. Sp. gr. $=2.6$, -3.0.

Description.—Colours white, grey, green, and violet-blue. Occurs regularly crystallized; also in prismatic concretions and massive. Lustre vitreous, inclining to resinous, and shining and glistning. Fracture conchoidal, passing into uneven. Translucent and transparent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs along with galena in the lead-mines of Leadhills, and in secondary trap-rocks in different parts of Scotland.

2. *Rhomboidal Limestone.*—Jameson.

Rhomboedrisches Kalk-Haloide, *Mohs.*—Chaux carbonatee, *Hauy.*—Kalk-spath, *Werner.*

Specific Character.—Rhomboidal. Rhomboid $=105^\circ 5'$. Cleavage, R. Hardness $=3.0$. Sp. gr. $=2.5$, -2.8.

Description.—Colours very varied, but of all the tints, white and grey are the most frequent; besides these, the following kinds also occur, viz. red, blue, green, yellow, brown, and rarely black. Occurs regularly crystallized, and of all known minerals, exhibits the greatest number of varieties of the rhomboidal series of crystallization; also in granular, prismatic, tabular, and globular distinct concretions. Its other forms are massive, disseminated, globular, botryoidal, reniform, tuberose, stalactitic, tubular, claviform, coralloidal, cellular, and curtain-shaped. Its lustre varies from splendent to dull, and is vitreous, inclining sometimes to pearly, sometimes to resinous. Fracture splintery, conchoidal, earthy, and uneven. Alternates from transparent to opaque. Generally brittle, and easily frangible.

Those varieties which are regularly crystallized, and possess high degrees of transparency, are named *calcareous-spar*; those in angulo-granular distinct concretions, with a lower lustre and transparency than the former, are the *foliated granular limestone*, or *crystalline marble* of authors; the varieties with splintery or conchoidal fractures are named *compact limestone*; other varieties having a grey or brown colour, dull earthy fracture, and which, on rubbing, give out a sulphureo-bituminous smell, are named *stinkstone*; the black varieties in granular and prismatic concretions, or with a compact fracture, with a glimmering or shining lustre, and low degree of translucency on the edges or complete opacity, and which, on rubbing, yield a sulphureo-bituminous odour, are named *anthraconite*; those limestones which have the oolitic structure, or are composed of spherical granular concretions, set on a marly basis, are named *roestone* or *oolite*; the soft varieties with earthy fracture and white colour are named *chalk*; the varieties with dull fracture surface, in loosely cohering pieces and crusts, and so light as nearly to swim upon water, are named *agaric mineral*; the fibrous varieties are named *common fibrous limestone or satin-spar*, and *fibrous calc-sinter*, or calcareous alabaster; the earthy looking opaque varieties that occur in many particular external shapes, near calcareous springs, and on the borders of lakes, are named *calc-tuff*; while the varieties in spherical round granular concretions, and concentric lamellar concretions, found near hot springs, are named *pea stone*; the *slate-spar* of mineralogists is a variety in lamellar concretions, with a beautiful pearly lustre and feeble translucency; varieties with earthy fracture, more or less inclined to splintery and conchoidal, are named *marl*; and, lastly, the opaque dull black varieties, with slaty fracture, are named *bituminous marl-slate.*

Geognostic Situation.—This mineral is one of the most abundant and widely distributed with which we are acquainted. Calcareous spar, one of its principal kinds, occurs in every rock from granite to the newest member of the secondary series. It generally occurs in veins with numerous metalliferous minerals, and assists in an eminent degree in characterizing the vast host of mineral veins in primitive, transition, and secondary rocks. In the state of granular, foliated, and compact limestones, also in the form of oolite, chalk, and Lucullite, it forms beds, hills, mountains, and even ranges of mountains. The beautiful fibrous limestone or satin spar occurs in veins in clay slate, and in rocks of the coal formation, while all the beautiful forms of calc-sinter are met with ornamenting the walls and floors of caverns in limestone and other formations; calc tuff abounds around cold, and also warm springs, frequently incrusting organic bodies, forming the calcareous incrustations so well known to mineralogists. Peastone is also a production of warm springs. The white, porous, and nearly supernatant mineral agaric incrusts rocky cliffs, particularly in limestone hills, and the rare variety, named slate spar, has hitherto been found only in primitive limestone.

Geographic Situation.—England and Scotland abound in interesting varieties of calcareous spar, and the mountains, hills, and valleys of Great Britain afford numerous localities of many of the different kinds of marble, limestone, chalk, marl, Lucullite, and oolite, while its calcareous springs, and caves and caverns, exhibit numerous deposites of calc tuff and of calc sinter.

3. *Macrotypous* Limestone.*—Jameson.

Macrotypes Kalk-haloid, *Mohs*—Braunspath, Rhombspath-Dolomite, *Werner.*—Chaux carbonatée ferrifere perlée, Chaux carbonatée magnesifere, *Haüy.*

Specific Character.— Rhomboidal. Rhomboid 106° 15′. Cleavage, rhomboidal. Hardness =3.5, —4.0. Sp. gr. =2.8,— 2.95.

Description—Colours white, grey, brown, red, and green. Occurs crystallized in rhomboids, in granular and prismatic concretions; massive, disseminated, globular, stalactitic, reniform, and with tabular and pyramidal impressions. Lustre varies from shining to glimmering, and is pearly, sometimes inclining to vitreous. Fracture splintery, conchoidal, and slaty. Varies from transparent to translucent on the edges. Brittle, and easily frangible.

The white varieties in small and fine granular concretions, which are sometimes so loosely aggregated, as to separate by the mere pressure of the finger, are the *dolomite-marble* of mineralogists; the *magnesian limestone* of England is a dolomite with brown colours, the green varieties are described under the name *Miemite*, from Miemo in Tuscany, where they were first found; the brown, red, reddish white, and pearl grey varieties, with very distinct pearly lustre, are arranged together, and described under the names *brown spar* and *pearl spar.*

Geognostic and Geographic Situations.—The dolomite marble occurs in the island of Iona; the brown dolomite constitutes a secondary limestone formation very abundant in England; the brown spar and pearl spar are not unfrequent in the lead-mines of Scotland and England.

4. *Brachytypous† Limestone or Rhomb-Spar.*—Jameson.

Brachytypes Kalk-haloid, *Mohs.* Rautenspath, *Werner.* Chaux carbonatée magnesifere, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid =107° 22′. Cleavage rhomboidal. Hardness =4.0, —4.5. Sp. gr. =3.0, —3.2.

Description.—Colours white, grey, and yellow. Occurs crystallized in rhombs; also massive and disseminated. Lustre splendent and vitreo-pearly. Fracture imperfect conchoidal. More or less translucent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs imbedded in chlorite-slate on the banks of Loch Lomond, and associated with galena, copper pyrites, and blende, near Newton Stewart, in Galloway.

Order II.—Baryte.

No true metallic lustre. Streak, white and grey, or orange yellow. Hardness=2.5, —5.0. Sp. gr. =3.3, —7.3. If adamantine, or imperfect metallic lustre, the Sp. gr. =6.0 and more. If the streak is orange-yellow, the Sp. gr. =6 and more; and the hardness =3.0 and less. If the Sp. gr. is under 4.0, and the hardness =5.0, the cleavage is diprismatic.

Genus I.—Sparry Iron.

Rhomboidal. Hardness =3.5 —4.5. Sp. gr. =3.6, —3.9.

1. *Rhomboidal Sparry Iron.*—Jameson.

Brachytyper Parachros Baryte, *Mohs.*—Spath Eisenstein, *Werner.*—Fer Oxydé Carbonaté, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid = 107. Cleavage, rhomboidal.

Description.—Colours yellow, white, brown, and black. Occurs crystallized in rhombs; also in granular concretions, massive and disseminated. Internally, lustre pearly, and varying from shining to glimmering, and even to splendent. Fracture sometimes splintery. Translucent on the edges. Rather brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in metalliferous veins, and in common veins, in primitive, transition, and secondary rocks in different parts of Great Britain and Ireland.

* *Sphærosiderite.*

Feroxyde carbonatée concretionné.

Colours brownish black, blackish brown, yellow, and grey. Occurs in stellular fibrous concretions, also globular, reniform, and small botryoidal. Lustre shining and resino-pearly. Fracture uneven. Ranges from semitransparent to opaque. Occurs in drusy cavities in secondary trap rocks, along with calcareous spar, arragonite and calcedony, at Steinheim near Hanau, in Germany.

Genus II.—Red Manganese.

Hardness =3.5. Sp. gr. =3.3, —3.6

1. *Rhomboidal Red Manganese.*—Jameson.

Macrotyper Parachros Baryte, *Mohs.* Rother Braunstein, *Werner.* Manganese Oxide Carbonaté *Haüy.*

Specific Character.—Rhomboid =10(° 51′. Cleavage, rhomboidal.

Description.—Colours red and brown. Occurs in granular concretions, also in fibrous concretions which are scopiformly and stellularly arranged, massive, and reniform. Lustre varies from shining to glimmering, and pearly. Fracture splintery. More or less translucent on the edges; in some rare varieties translucent. Brittle, and rather easily frangible.

The varieties with distinct cleavage are named *foliated red manganese;* those in fibrous concretions *fibrous red manganese;* and the splintery varieties, *compact red manganese.*

Geognostic and Geographic Situations.—Occurs at Kapnic, in Transylvania, and at Catharinenberg, in Siberia.

* *Manganese Spar.*—Jameson.

Rothstein. Manganèse Oxyde Silicifère.

Specific Character.—Colour bright rose-red. Occurs massive and disseminated. Lustre intermediate

* From μακρός, *long;* and τύπος, *the type* (fundamental form).

† From βραχύς, short, and τύπος, *the type.*

between pearly and vitreous. Cleavage sometimes visible. Fracture conchoidal or splintery. Translucent on the edges. Hardness =5.0, —5.5. Sp. gr. =3.5, —3.7.

Geognostic and Geographic Situations.—Occurs in beds of magnetic iron-ore and iron-glance, in gneiss at Langbanshytta, in Wermeland in Sweden.

Genus III.—Calamine.

Zinc-Baryt, *Mohs.*

Rhomboidal. Prismatic. Hardness =5.0. Sp. gr. =3.3, —4.5. If rhomboidal, the Sp. gr. above 4.0.

1. *Prismatic Calamine, or Electric Calamine.*—Jameson.

Prismatischer Zink-Baryt, *Mohs.* Zink Oxydé, *Hauy.*

Specific Character.—Prismatic. Pyramid =134° 59′; 99° 56′; 96° 56′. P+∞ 118° 29′. Cleavage, $\overset{o}{\mathrm{Pr}}$=120°. More distinct, $(\overset{o}{\mathrm{Pr}}+\infty)^3$=80° 4′. (Fig. 43.) Hardness =5.0. Sp. gr. =3.3, —3.6.

Description.—Most frequent colours white and yellow; also green, grey, yellow, and brown; and with curved striped colour delineations. Occurs regularly crystallized, and in distinct concretions, which are scopiform radiated, and scopiform fibrous, granular, and curved lamellar. Massive, in crusts, stalactitic, reniform, botryoidal, and cellular. Internally alternates from glistning to dull, and lustre pearly, inclining to adamantine. Fracture small and fine-grained uneven. Varies from transparent to opaque.

Geognostic and Geographic Situations.—Occurs in veins of galena, in greywacke, and clay-slate, and in beds, and imbedded masses in secondary limestone. Is found in the lead mines of Wanlockhead, and in the mines of Flintshire and Leicestershire.

2. *Rhomboidal Calamine.*—Jameson.

Rhomboedrischer Zink-baryt, *Mohs.*—Galmei, *Werner.*—Zink carbonaté, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid= 110° (nearly). Cleavage, rhomboidal. Hardness= 5.0. Sp. gr. =4.2, —4.5.

Description.—Colours white, grey, green, yellow, and brown. Occurs regularly crystallized, and in distinct concretions, which are radiated, granular, and curved lamellar; massive, corroded, reniform, stalactitic, botryoidal, and cellular. Internally ranges from shining to dull, and is pearly. Fracture uneven, splintery, and flat conchoidal. Ranges from transparent to opaque.

Geognostic and Geographic Situations.—Occurs in beds, veins, nests, filling up or lining hollows, in transition limestone and in secondary limestone. Derbyshire, Somersetshire, Flintshire, and Durham, afford numerous localities of this mineral.

Genus IV.—Tungsten, or Scheelium.

Hardness =4.0, —4.5. Sp. gr. =6.0, —6.1.

1. *Pyramidal Tungsten.*—Jameson.

Pyramidaler Scheel-Baryt, *Mohs.*—Schwerstein, *Werner.*—Scheelin Calcaire, *Haüy.*

Specific Character.—Pyramidal. Pyramid =107° 26′; 113° 36′. Combination hemi-pyramidal with parallel planes. Cleavage, P. P+1=100° 8′; 130° 20′ P—∞.

Description.—White is the principal colour; but other varieties, as brown and orange-yellow, occasionally occur. Sometimes crystallized, and also in distinct concretions, which are granular, prismatic, and curved lamellar. Occurs massive and disseminated. External lustre shining and splendent; internal lustre shining and resinous. Fracture uneven or conchoidal. More or less translucent, seldom transparent.

Geognostic and Geographic Situations.—Occurs along with tinstone, wolfram, magnetic iron-ore, and brown iron-ore, in primitive rocks, as in Cornwall.

Genus V. Baryte.

Hardness =3.0,—3.5. Sp. gr. 3.6,—4.6.

1. *Pyramido-Prismatic Baryte, or Strontianite.*

Pyramido-prismatischer Hal-Baryt, *Mohs.*—Strontian, *Werner.*—Strontiane Carbonaté, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $\overset{o}{\mathrm{Pr}}$. P+∞=117° 19′. $\overset{o}{\mathrm{Pr}}$+∞. (Fig. 46.) Hardness =3.5. Sp. gr. 3.6,—3.8.

Description.—Colours green and grey. Occurs regularly crystallized, and in distinct concretions, which are scopiform radiated, and scopiform fibrous. Lustre shining, glistning, and pearly. Fracture uneven. More or less translucent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs at Strontian in Scotland in veins of lead glance that traverse gneiss.

2. *Di-prismatic Baryte or Witherite.*—Jameson.

Di-prismatischer Hal-baryt, *Mohs.* Witherit, *Werner.* Baryte carbonatée, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $\overset{o}{\mathrm{Pr}}$. P+∞=120° (nearly). $\overset{o}{\mathrm{Pr}}$+∞. (Fig. 46.) Hardness =3.0,—3.5. Sp. gr. =4.2, —4.4.

Description.—Colours white, grey, and yellow. Occurs regularly crystallized, and also in distinct concretions, which are radiated and granular. Occurs massive, cellular, globular, botryoidal, reniform, and stalactitic. Lustre shining and resinous. Fracture uneven, inclining to splintery. Translucent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in galena veins, that traverse limestone and sandstone, in Cumberland and Durham.

3. *Prismatic Baryte, or Heavy-Spar.*—Jameson.

Prismatischer Hal-baryte, *Mohs.*—Schwerspath, *Werner.*—Baryte sulphatée, *Hauy.*

Specific Character.—Prismatic. Pyramid =128° 54′; 91° 20′; 110° 25′. P+∞=116° 38′. Cleavage $\bar{\mathrm{Pr}}$=78° 28′. $\overset{o}{\mathrm{Pr}}$+∞. Fig. 45. Less distinct, P—∞. $\bar{\mathrm{Pr}}$+∞. (Fig. 33, 29, 27, 28.) Hardness =3.0, —3.5. Sp. gr. =4.1, —4.6.

Description.—Colours white, grey, black, blue,

green, yellow, red, and brown. Occurs regularly crystallized; also in granular, lamellar, fibrous, and prismatic distinct concretions; massive, disseminated, reniform, botryoidal, and globular. Lustre alternates from splendent to glimmering, and resinous or pearly, inclining to vitreous. Fracture uneven, splintery, and earthy. Alternates from transparent to opaque. Brittle, and very easily frangible.

The varieties with uneven and splintery fracture are named *compact h. spar;* those in fine granular concretion *granular h. spar;* the lamellar varieties are named *straight or curved lamellar h. spar,* according to the direction of the lamellar concretion; the fibrous varieties *fibrous h. spar;* the radiated varieties *radiated h. spar;* those in prismatic concretions *prismatic h. spar;* the varieties which, on rubbing, emit a hepatic smell, *fœtid h. spar, or hepatite;* and those which occur in the earthy or powdery state, *earthy h. spar.*

Geognostic and Geographic Situations.—It occurs in veins, either alone or associated with various metalliferous formations of silver, copper, lead, cobalt, antimony, manganese, zinc, arsenic, iron, &c. in rocks of the primitive, transition, and secondary classes. Numerous localities of this mineral occur in Scotland, England, and Ireland.

4. *Prismatoidal Baryte, or Celestine.*—Jameson.

Prismatoidischer Hal-baryt, *Mohs.*—Coelestin, *Werner.*—Strontiane sulphatée, *Hauy.*

Specific Character.—Prismatic. Pyramid $=128^{0}$ $14'$; 113^{0} $26'$; 90^{0} $57'$; $P+\infty=103^{0}$ $0'$. Cleavage, $\bar{Pr}=104^{0}$ $48'$. More distinct, $\breve{Pr}+\infty$. (Fig. 45.) Less distinct, $P-\infty$ $\bar{Pr}+\infty$. (Fig. 33, 29, 27, 28.) Hardness $=3.0$, -3.5. Sp. gr. $=3.6$, -4.0.

Description.—Colours white, blue, and red. Occurs regularly crystallized; in granular, fibrous, and radiated distinct concretions; massive and stalactitic. Lustre alternates from splendent to glimmering, and is pearly. Ranges from transparent to translucent on the edges.

Geognostic and Geographic Situations.—Occurs in limestone, in red sandstone, and gypsum, where it is associated with sulphur, and in vesicular cavities in amygdaloid. It has been found in sandstone near Inverness; in the amygdaloid of the Calton Hill; in the neighbourhood of Bristol; and near Knaresborough, in Yorkshire.

Genus VI.—Lead Spar.

Blei-baryt, *Mohs.*

Rhomboidal, pyramidal, prismatic. Hardness $=2.5$, -4.0. Sp. gr. $=6.0$, -7.3. If the hardness is above 3.5, the sp. gr. $=6.5$, and more.

1. *Di-prismatic Lead-Spar, or White Lead-Spar.*—Jameson.

Di-prismatischer Blei-baryt, *Mohs.*—Plomb carbonatée, *Hauy.*

Specific Character.—Prismatic. Pyramid $=130^{0}$ $0'$; 108^{0} $28'$; 92^{0} $19'$. $P+\infty=108^{0}$ $16'$. Cleavage, $\breve{Pr}=117^{0}$ $13'$. $(\breve{Pr}+\infty)^{3}=69^{0}$ 20. (Fig. 43.) Hardness $=3.0$, -3.5. Sp. gr. $=6.3$, -6.6.

Description.—Principal colour white, occurs also black, yellow, brown, and grey. Occurs regularly crystallized; massive and cellular. Lustre externally ranges from splendent to shining; internally from shining to glistning, and is adamantine, inclining more or less to resinous and imperfect metallic. Fracture uneven and conchoidal. Ranges from transparent to opaque. Streak greyish-white.

Geognostic and Geographic Situations.—Occurs in veins in granite, gneiss, mica slate, and clay slate; also in limestone, greywacke, and in various secondary formations. Well known localities are Leadhills and Wanlockhead.

2. *Rhomboidal Lead-Spar, or Green and Brown Lead-Spar.*—Jameson.

Rhomboedrischer Blei-Baryt, *Mohs.* Plomb Phosphaté, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid $=117^{\circ}$ $23'$. Combination, di-rhomboidal. $2\,(R)'=134^{0}$ $15'$; 101° $32'$. Cleavage, $P+1=141^{\circ}$ $47'$; 81° $46'$. Hardness $=3.5$, -4.0. Sp. gr. $=6.9$, -7.3.

Description.—Colours green, brown, and sometimes yellow and white. Occurs regularly crystallized; also in granular, radiated, and curved lamellar concretions. Lustre externally shining, internally glistening, and resinous. Fracture uneven or splintery. Ranges from translucent to translucent on the edges. Streak white.

Geognostic and Geographic Situations.—Occurs in veins, and most abundantly in their upper part, in various rocks of the primitive, transition, and secondary classes, where it is associated with galena, white lead-spar, &c. Leadhills and Wanlockhead are well known localities.

3. *Hemi-Prismatic Lead-Spar, or Red Lead-Spar.*

Hemi-prismatischer Blei-Baryt, *Mohs.*—Roth Bleierz, *Werner.*—Plomb Chromaté, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, hemi-prismatic. Cleavage, $P+\infty=90^{\circ}$ (nearly), $\breve{Pr}+\infty$, $Pr+\infty$. (Fig. 30, 29, 28.) Hardness $=2.5$. Sp. gr. $=6.0$, -6.1.

Description.—Colour hyacinth red. Occurs regularly crystallized; also massive, and in flakes. Internally shining or splendent, and lustre adamantine. Fracture uneven, sometimes imperfect conchoidal. More or less translucent. Streak between lemon-yellow and orange-yellow. Nearly sectile, and easily frangible.

Geognostic and Geographic Situations.—Occurs in a granular quartzy rock, associated with brown ironstone, iron-pyrites, green lead-spar, native gold, galena, and quartz, in Siberia; also in sandstone in the Brazils.

Green Chromate of Lead.

The green and liver-brown coloured mineral, in small reniform and stalactitic forms, which accompanies the red lead-spar of Siberia, and also that of Brazil, according to Berzelius, contains the following constituent parts: Oxide of lead, 60.87 oxide of copper, 10.80; chromic acid, 28.33=100.;

4. *Pyramidal Lead-Spar, or Yellow Lead-Spar.*

Pyramidaler Blei-Baryt, *Mohs.*—Gelb Bleierz, *Werner.*—Plomb molybdate, *Hauy.*

Specific Character.—Pyramidal. Pyramid =99° 40′; 131° 35′. Cleavage, P—∞. P. Hardness = 3.0. Sp. gr. =6.5, —6.9.

Description.—Colour yellow. Occurs crystallized; also massive, in crusts, and cellular. Externally generally splendent and shining; internally shining or glistning, and lustre resino-adamantine. Fracture uneven and conchoidal. Translucent, or translucent on the edges.

Geognostic and Geographic Situations.—Occurs in compact limestone, at Bleiberg in Carinthia; also in France and Saxony.

5. *Prismatic Lead-Spar, or Sulphate of Lead.*

Prismatischer Blei-Baryt, *Mohs.*—Vitriol Bleierz, *Werner.*—Plomb sulphaté, *Hauy.*

Specific Character.—Prismatic. Pyramid =122° 35′; 94° 25′; 112° 37′. P+∞ =109° 28′. Cleavage, Pr=78° 28′. More distinct, Pr+∞. (Fig. 45.) Hardness =3.0. Sp. gr. =6.2, —6.3.

Description.—Colour white, seldom green or wine yellow, or blue (owing to blue malachite). Occurs regularly crystallized; in granular distinct concretions; also massive and disseminated. Lustre adamantine, and ranging from splendent to shining. Fracture conchoidal. Transparent or translucent.

Geognostic and Geographic Situations.—Occurs in galena veins, at Leadhills and Wanlockhead; and also in the Pary's Mine in Anglesea.

1. *Corneous Lead Ore, or Muriat of Lead.*—This rare mineral, which has been hitherto found only in Derbyshire, has not been described in a satisfactory manner.

Appendix of undetermined Lead-Spars.

2. *Arseniate of Lead.*—This is a rare mineral, hitherto not well described. Is found in Cornwall, and in several mines in France and Spain.

3. *Plomb Gomme.*—This rare mineral is of a reddish or yellowish brown colour, and the colours are disposed in stripes. Occurs small reniform, and in fibrous concretions. It is shining and translucent. It is a compound of oxide of lead, alumina, and water, according to Berzelius. It has been hitherto found only in the lead mines of Huelgoet in France.

N. B.—It bears a striking resemblance to hyalite.

Order III.—Kerate.

No metallic lustre. Streak white or grey. No single distinct cleavage. Hardness =1.0, —2.0. Sp. gr. =5.5.

Genus I.—Corneous Silver.

Hardness =1.0, —2.0. Sp. gr. =5.5, 5.6.

1. *Hexahedral Corneous Silver.*—Jameson.

Hexedrisches Perl Kerat, *Mohs.*—Hornerz, *Werner.*—Argent Muriaté, *Hauy.*

Specific Character.—Tessular. Cleavage not visible. Malleable. Sectile.

Description.—Colour pearl-grey, which passes into white, blue, and green; on exposure to light becomes brown. Occurs crystallized; in prismatic and granular concretions; massive and in flakes. Lustre ranges from shining to glistening, and is resinous. Fracture conchoidal. Translucent, or feebly translucent on the edges. Becomes shining in the streak.

Geognostic and Geographic Situations.—Occurs in silver-mines in Siberia, America, and has also been found in Cornwall.

Genus II.—Corneous Mercury.

Hardness =1.0, 2.0. Sp. gr. unknown.

1. *Pyramidal Corneous Mercury.*—Jameson.

Pyramidales Perl Kerate, *Mohs.*—Quecksilber Hornerz, *Werner.*—Mercure, Muriaté, *Hauy.*

Specific Character.—Pyramidal. Pyramid unknown. Cleavage, P+∞, imperfect. Sectile.

Description.—Colour grey. Occurs generally in very minute crystals in vesicular cavities. Lustre shining and adamantine. Faintly translucent.

Geognostic and Geographic Situations.—Occurs in the mercury-mines of Almaden, Idria, and Bohemia.

Order IV.—Malachite.

No metallic lustre. Colour blue, green, brown. No single distinct faces of cleavage. Hardness = 2.0,—5.0. Sp. gr. =2.0,—4.6. If brown, in colour or in streak, the hardness =3.0. and less; and the specific gravity above 2.5. If white in the streak, the specific gravity =2.2, and less; and the hardness under 3.0.

Genus I.—Copper Green.

Staphylin Malachit, *Mohs*

Uncleavable. Hardness =2.0,—3.0. Sp. gr. = 2.0,—22.

1. *Uncleavable Copper Green.*—Jameson.

Untheilbarer Staphylin-Malachit, *Mohs.* Kupfergrün, *Werner.* Cuivre Carbonaté, *Hauy.*

Specific Character.—Reniform, botryoidal. No cleavage.

Description.—Colour green. Occurs massive, disseminated, in crusts, reniform, and botryoidal. Lustre shining, glistning, and resinous. Fracture small, conchoidal. Ranges from translucent to translucent on the edges. Colour does not change in the streak.

Geognostic and Geographic Situations.—Occurs in copper-mines in Cornwall.

Genus II.—Liriconite.*

Lirikon-Malachit, *Mohs.*

Tessular, prismatic. Hardness =2.5. Sp. gr. = 2.8,—3.0.

1. *Prismatic Liriconite, or Lenticular Arseniate of Copper.*—Jameson.

Prismatischer Lirikon-Malachit, *Mohs.*—Linsenerz, *Werner.*—Cuivre arseniaté, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, Pr. P+∞. (Fig. 35, 30.) Streak pale verdigris-green,...Sky-blue. Hardness =2.5. Sp. gr. =2.8,—3.0.

* From λειρος, pale, and κονια, dust (the streak).

Description.—Colour blue, inclining more or less to verdigris-green. Occurs regularly crystallized. Lustre shining, glistening, and pearly, passing to vitreous. Fracture uneven. Translucent. Brittle, and uncommonly easily frangible.

Geognostic and Geographic Situations.—Occurs in the copper-mines of Cornwall.

2. *Hexahedral Liriconite, or Cubical Arseniate of Iron.*—Jameson.

Hexaedrischer Liricon-Malachit, *Mohs.*—Wurfelerz, *Werner.*—Fer Arseniaté, *Hauy.*

Specific Character.—Tessular. Combination, semitessular, with inclined planes. Cleavage, hexahedral. Streak pale olive-green,...brown. Hardness =2.5. Sp. gr. =2.9,—3.0.

Description.—Colour green. Occurs regularly crystallized, and massive. Lustre glistening and vitreo-resinous. Translucent, or translucent on the edges.

Geognostical and Geographical Situations.—Occurs in the copper-mines of Cornwall.

Genus III.—Olivenite.

Oliven-Malachit, *Mohs.*

Prismatic. Colour or streak neither blue nor bright green. Hardness =3.0, 4.0. Sp. gr. =3.6,—4.6.

1. *Prismatic Olivenite*, or *Prismatic Arseniate Copper.*—Jameson.

Prismatischer Oliven-Malachit, *Mohs.*—Olivenerz, *Werner.*—Cuivre Arseniate, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P+∞. (Fig. 30.) Streak olive-green,...brown. Hardness =3.0. Sp. gr. =4.2, —4.6.

Description.—Principal colour olive-green, also yellow, brown, and white. Occurs regularly crystallized; in concretions which are scopiform fibrous, angulo-granular, and curved lamellar; massive and in drusy crusts. Lustre ranges from splendent to glimmering, and is resinous, inclining to pearly, or pearly. Ranges from transparent to opaque.

Geognostic and Geographic Situations.—Occurs in the copper-mines of Cornwall.

2. *Diprismatic Olivenite.*—Jameson.

Diprismatischer Oliven-Malachit, *Mohs.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage unknown. Streak olive-green. Hardness =4.0. Sp. gr. =3.6, —3.8.

Description.—Colours grass, olive, leek, and pistachio green. Occurs regularly crystallized. Lustre vitreous and pearly. Fracture conchoidal. Ranges from semi-transparent to translucent.

Geognostic and Geographic Situations.—Occurs in drusy cavities in micaceous clay-slate, with quartz and tile-ore; sometimes also with copper pyrites, at Libethen, in Hungary.

Genus IV.—Blue Malachite, or Blue Copper.

Lazur Malachit, *Mohs.*

Prismatic. Blue. Hardness =3.5, —4. Sp. gr. =3.5, —3.7.

1. *Prismatic Blue Malachite*

Prismatischer Lazur Malachit, *Mohs.*—Kupferlazur, *Werner.*—Cuivre Carbonaté Bleu, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, hemi-prismatic. Cleavage prismatic Streak blue.

Description.—Colours blue. Occurs regularly crystallized; in concretions which are scopiform and stellular, radiated, and also curved lamellar; massive, globular, botryoidal, reniform, stalactitic, and cellular. Lustre ranges from shining to glimmering, and is vitreo-resinous. Fracture conchoidal. Ranges from transparent to translucent on the edges.

A variety, in dull and fine dusty particles, is named *earthy blue malachite*, while the other varieties are denominated *radiated blue malachite.*

Geognostic and Geographic Situations.—Occurs in mineral veins and in beds in gneiss, mica slate, greywacke, limestone, and red sandstone. It occurs at the Lead Hills, and in various English copper and lead mines.

* *Velvet Blue Copper.*

Kupfersammterz, *Werner.*

Description.—Occurs in bright blue, short capillary crystals. Lustre glistening and silky.

Geognostic and Geographic Situations.—It is a rare mineral; its only known locality is the Bannat, where it is associated with green malachite and brown iron-ore.

Genus V.—Emerald Malachite.

Smaragd-Malachite, *Mohs.*

Hardness =5.0. Sp. gr. =3.2, —3.4.

1. *Rhomboidal Emerald Malachite*—Jameson.

Rhomboedrischer Smaragd-Malachit, *Mohs.*—Kuferschmaragd, *Werner.*—Cuivre Dioptase, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid = 123°58′. Cleavage rhomboidal. Streak green.

Description.—Colour emerald-green. Occurs regularly crystallized. Internally shining and pearly. Fracture conchoidal. Translucent, passing into semitransparent.

Geognostic and Geographic Situations.—Is a very rare mineral, and has hitherto been found only in the land of the Kirgies in Tartary.

Genus VI.—Green Malachite.

Habronem-Malachit, *Mohs.*

Prismatic. Colour or streak bright-green Hardness =3.5, —5. Sp. gr. =3.5, —4.3.

1. *Prismatic Green Malachite*, or *Phosphat of Copper.*—Jameson.

Prismatischer Habronem-Malachit, *Mohs.*—Phosphor Kupfererz, *Werner.*—Cuivre Phosphaté, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown Cleavage, P+∞ =110° (nearly.) (Fig. 30.) Streak emerald-green. Hardness =5.0. Sp. gr. =4.0, —4.3.

Description.—Colours emerald-green, externally with a blackish tarnish, or spotted black. Occurs regularly crystallized; in scopiform fibrous concretions; massive, reniform, botryoidal. Lustre ranges

from shining to glimmering and is resino-pearly. Fracture uneven. Opaque.

Geognostic and Geographic Situations.—Occurs at Virneberg, near Rheinbreitenbach, where it is disposed in veins in greywacke.

2. *Diprismatic Green Malachite,* or *Common Malachite.*—Jameson.

Diprismatischer Habronem-Malachit, *Mohs.*—Malachit, *Werner.*—Cuivre Carbonaté Vert, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $\bar{Pr}$. $P+\infty=103°$ (nearly). (Fig. 33, 30.) Streak grass or apple green. Hardness = 3.5,...4.0. Sp. gr. =3.5,...3.7.

Description.—Colour green. Occurs regularly crystallized; in distinct concretions, which are scopiform, fibrous, angulo granular, and wedge-shaped; also massive, disseminated, tuberose, stalactitic, reniform, botyroidal, fruticose, and cellular. Lustre ranges from shining to glimmering, and is silky Fracture uneven, conchoidal, and even. Ranges from translucent to opaque.

Geognostic and Geographic Situations.—Occurs in veins that traverse primitive, transition, and secondary rocks; also in beds, and disseminated through rocks of different kinds. The copper-mine of Sandlodge, in Shetland, formerly afforded fine specimens of the fibrous varieties; and fine masses are sometimes found in the copper-mines of Cornwall.

* ATACAMITE.

Streak leek....grass green, 2.5. Sp. gr. =4.4.

1. *Prismatic Atacamite,* or *Muriat of Copper.*—Jameson.

Cuivre Muriate, *Haüy.*

Specific Character.—Prismatic. Cleavage very perfectly prismatoidal.

Description.—Colour green. Occurs regularly crystallized; in radiated and granular concretions; massive, disseminated, and in scaly particles. Lustre shining, glistening, and pearly. Translucent on the edges.

Geognostic and Geographic Situations.—Occurs in veins along with ores of copper in Chili, in the form of grains and scales in alluvial sand in the Desart of Atacama in Peru. Is also found in fissures of some Vesuvian lavas.

Order V.—MICA.

Cleavage montomous and very distinct. Hardness =1.0, —4.5. Sp. gr. =1.8,—5.6.

If metallic lustre, the sp. gr. is under 2.2. If no metallic lustre, the sp. gr. is above 2.2. If the streak is yellow, the sp. gr. is under 3.2.

If the hardness is above 2.5, it is rhomboidal. If the sp. gr. is under 2.5, it is metallic. If above 4.4, the streak is white or grey.

Genus I.—COPPER MICA.

Streak green. Hardness =2. Sp. gr. =2.5,—2.6.

1. ***Rhomboidal Copper Mica,*** or ***Micaceous Arseniate of Copper.***—Jameson.

Rhomboedrischer Euchlor-glimmer, *Mohs.* —Kupferglimmer, *Werner.*—Cuivre Arseniaté, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid unknown. Cleavage R—∞. Streak emerald,...apple-green.

Description.—Colour green. Occurs regularly crystallized; in granular concretions; massive, and disseminated. Internally splendent and pearly. Fracture uneven. Translucent and transparent. Sectile.

Geognostic and Geographic Situations.—Occurs in the copper-mines of Cornwall.

Genus II.—URAN-MICA, or URANITE.

Streak green,...yellow. Hardness =2.0, —2.5. Sp. gr. =3.0, —3.2.

1. *Pyramidal Uran Mica.*—Jameson.

Pyramidaler Euchlor-glimmer, *Mohs.*—Uranglimmer, *Werner.*—Uran Oxydé, *Haüy.*

Specific Character.—Pyramidal. Pyramid =95° 13'; 144°56'. Cleavage, P—∞.

Description.—Colours green and yellow. Occurs regularly crystallized; seldom massive, in scales, and in angulo-granular concretions. Lustre ranges from splendent to glistening, and is pearly. Transparent and translucent. Sectile. Not flexible. Easily frangible.

Geognostic and Geographic Situations.—Occurs in the copper and tin-mines of Cornwall.

* *Uran Ochre.*—This is the yellow or reddish coloured, soft, earthy looking, opaque mineral, occasionally associated with uran-mica, and also with uran-ore.

Genus III.—COBALT MICA, or RED COBALT.

Kobalt Glimmer, *Mohs.*

Prismatic. Hardness =2.5. Sp gr. =4.0,—4.3.

1. *Prismatic Cobalt Mica,* or *Red Cobalt.*—Jameson.

Prismatischer Kobalt Glimmer, *Mohs.*—Rother Erd Kobalt, *Werner.*—Cobalt Arseniaté, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination hemi-prismatic, $\frac{P}{2}$ Cleavage, $\breve{Pr}+\infty$. (Fig. 29.) Streak red,...green.

Description.—Colours red, rarely grey, green, and brown. Occurs regularly crystallized; in stellular and scopiform fibrous concretions; massive, disseminated, in crusts, reniform, and botryoidal. Lustre ranges from shining to dull, and is pearly and resinous. Fracture earthy and conchoidal. Sectile. Ranges from translucent to opaque.

Geognostic and Geographic Situations.—Occurs in veins in primitive and secondary rocks, and is met with in the coal-field around Edinburgh, and in the old lead-mines of Tyndrum in Perthshire.

* *Cobalt Ochre.*—There are three kinds of this mineral, which we shall now describe.

1. *Black Cobalt Ochre.*—Schwarz Erd Kobolt, *Werner.*

Colours black and occasionally brown. Occurs botryoidal, reniform, and in crusts. Lustre glimmering or dull. Fracture earthy and conchoidal. Opaque. Streak shining and resinous. Very soft, and sometimes friable.

It is a compound of black oxide of cobalt, with arsenic and oxide of iron.

It occurs at Alderly Edge, Cheshire, in red sandstone.

2. *Brown and Yellow Cobalt Ochre.*—These differ from the preceding principally in colour, the tints being yellow and brown.

Genus IV.—Antimony Mica, or White Antimony.

Antimon-glimmer, *Mohs.*
Hardness =1.5,—2.0. Sp. gr. =5.0, —5.6.

1. *Prismatic White Antimony.*—Jameson.

Prismatisches Antimon glimmer, *Mohs.*—Weiss-spiess-glaserz, *Werner.*—Antimoine Oxydé, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatoidal. Streak, white or grey.

Description.—Colours white and grey. Occurs regularly crystallized; in concretions which are scopiform and stellular radiated, and also granular. Lustre shining and pearly-adamantine. Translucent.

Geognostic and Geographic Situations.—It occurs in veins in primitive rocks, along with galena and grey and red antimony, in Bohemia, France, and Hungary.

* *Antimony Ochre.*—Spiesglanzocker, *Werner.*

Colours yellow, brown, and green. Occurs massive, disseminated, and in crusts. Dull. Earthy. Opaque. Very soft.

It always occurs in veins along with grey, and occasionally with red antimony, as in Cornwall.

Genus V.—Blue Iron, or Iron Mica.

Eisen Glimmer, *Mohs.*

Prismatic. Streak white, grey,...blue. Hardness =2.0. Sp. gr.=2.6.—2.7.

1. *Prismatic Blue Iron, or Phosphat of Iron.*—Jameson.

Prismatisches Eisen Glimmer, *Mohs.*—Vivianit, *Werner.*—Fer Phosphaté, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination hemiprismatic, $-\frac{P}{2}$. Cleavage, $\breve{P}r+\infty$. (Fig. 29.)

Description.—Colours blue and green. Occurs regularly crystallized; in scopiform and promiscuous fibrous concretions; massive, disseminated, and thinly coating. Lustre ranges from splendent to dull, and is pearly, inclining to adamantine. Ranges from transparent to opaque.

It sometimes occurs in a friable, or loosely cohering state, and is then composed of dull dusty particles, forming *earthy blue iron.*

Geognostic and Geographic Situations.—The crystallized varieties are found in Cornwall, those in fibrous concretions in Greenland, and the earthy and friable in our peat mosses

Genus VI.—Graphite.

Graphite Glimmer, *Mohs.*

Rhomboidal. Hardness =1.0,—2.0. Sp. gr.=1.8, —2.1.

1. *Rhomboidal Graphite.*—Jameson.

Rhomboedrischer Graphit-glimmer, *Mohs.*—Graphit, *Werner.*—Graphite, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid unknown. Combination dirhomboidal. Cleavage, R—∞. Metallic aspect. Streak black.

Description.—Colour dark steel-grey, inclining to iron-black. Occurs regularly crystallized; in granular concretions; massive and disseminated. Lustre ranges from splendent to glimmering, and is metallic. Fracture scaly foliated, uneven, conchoidal, and slaty. Opaque. Sectile.

Geognostic and Geographic Situations.—It occurs in beds and imbedded masses, in primitive, transition, and secondary rocks. In Scotland it occurs in gneiss, in Glen Strath Farrar, in Inverness-shire; in the coal-formation in Ayrshire; and in England, in transition rocks near Borrodale in Cumberland.

Genus VII.—Talc-Mica.

Talc-Glimmer, *Mohs.*

Rhomboidal. Prismatic. Streak white, grey,. green. Hardness =1.0,—2.5. Sp. gr. =2.7,—3.0.

1. *Prismatic Talc-Mica, or Talc.*—Jameson.

Prismatischer Talc-glimmer, *Mohs.*

Specific Character.—Prismatic. Pyramid unknown. P+∞=120° (nearly.) Cleavage, P—∞. (Fig. 27.) Flexible. Hardness =1.0, —1.5. Sp. gr. =2.7,—2.8.

Description.—Colours green, sometimes passing into greenish black, also greenish white, grey, and rarely blue. Occurs regularly crystallized; in granular, fibrous, and prismatic concretions; massive, disseminated, and in amygdaloidal pieces. Lustre ranges from splendent to dull, and is pearly or resinous. Fracture slaty, scaly foliated, earthy, and uneven. Ranges from translucent to opaque.

The dark green varieties, which are generally opaque, are named *chlorite;* of those the regularly crystallized are named *foliated chlorite;* the slaty, *chlorite slate;* the massive, scaly foliated, *common chlorite;* the massive in scaly foliated feebly cohering particles, *earthy chlorite;* and the dull earthy varieties met with in vesicular cavities in amygdaloid, *compact chlorite or green earth.* The white and paler green varieties are named *talc;* of these the most translucent, and possessing the highest degree of lustre, are denominated *common talc;* while the grey and green varieties, with slaty fracture and inferior lustre, and inferior translucency, are named *talc slate* or *indurated talc.*

Geognostic and Geographic Situations.—Occurs principally in primitive mountains, sometimes forming whole beds, as is the case with the varieties named chlorite slate, and talc-slate; other kinds, as common and earthy chlorite, occur disseminated, in veins, or dispersed through other minerals, as rock crystal, felspar, &c. while the compact chlorite, or green earth, appears principally in secondary amygdaloid. The most beautiful variety of the species, the common talc, occurs only in primitive rocks of limestone, mica slate, &c. Examples of all the varieties are met with in the mountainous districts of Scotland and England.

1. *Native Magnesia, or Hydrate of Magnesia.*—

Colours snow white, greenish white, and also grey. Occurs in prismatic concretions that point to the regular six-sided prism, also in granular concretions, and massive. Cleavage probably rhomboidal. Lustre shining and pearly. Semitransparent in the mass, and transparent in single folia. Streak white, and affords on paper a polished pearly trace. Hardness, 1.5. Slightly elastic. Sp. gr. 2.13, *Bruce*. 2.336, *Brewster*. It is a pure hydrate of magnesia, the proportion of the constituent parts being magnesia 70. Water 30. Occurs in veins in serpentine, in the Shetland Islands and Portsoy.

2. *Ophite*, or Precious Serpentine.—Colours pure leek green, seldomer grass and oil green. Occurs massive and disseminated. Glistening and resinous lustre. Fracture flat conchoidal, inclining to splintery. Translucent, or translucent on the edges. Hardness 3.5. Sp. gr. =2.5,—3.0.

3. *Pikrolite*.—Colour leek green. Massive, and in scopiform fibrous concretions. Lustre glimmering, or dull and silky. Fracture splintery or even. Translucent on the edges. Scratches calc-spar, and is scratched by felspar.

It occurs in small veins in beds of magnetic iron ore, subordinate to gneiss, and also in serpentine, in Sweden.

4. *Nephrite*.—Colours green, grey, and white. Massive, and in rolled pieces. Dull or glimmering. Fracture splintery. Strongly translucent. Difficultly frangible. Hardness =7.0. Sp. gr. =2.9,—3.1.

It occurs imbedded in various primitive rocks in Persia, Egypt, and Germany.

5. *Steatite or Soapstone*.—Colours white, red, and yellow, with frequent dendritic markings of black. Occurs massive, in crusts, and in false crystals. Fracture splintery and uneven. Dull or glimmering. Translucent on the edges. Sectile. Soft. Feels very greasy. It occurs principally in serpentine, as in that of the Shetland Islands and Cornwall.

N. B. The *Pimelite* of authors appears to be steatite coloured with nickel or chrome.

6. *Figure-stone or Algalmatolite*.—Colours grey, green, white, red, and brown. Massive. Dull or glimmering. Fracture conchoidal, or splintery, and slaty combined. Translucent. Resinous in streak. Feels rather greasy. The finest varieties are brought to Europe from China.

7. *Magnesite*.—Colours white, grey, and cream-yellow. Occurs massive, tuberose, reniform, vesicular. Dull. Fracture conchoidal. Opaque. Hardness =3.3. Sp. gr. =2.881. Occurs in serpentine in Moravia, and in the Shetland Islands.

8. *Meerschaum*.—Colour white. Massive. Dull. Fracture earthy and conchoidal. Opaque or translucent on the edges. Very soft. Sectile. Adheres strongly to the tongue. Sp. gr. =0.988,—1.279. Occurs in serpentine in Cornwall, Shetland Islands, &c.

9. *Lithomarge*.—Colours white, grey, blue, green, red, and yellow, and these are sometimes disposed in a veined, spotted, clouded or striped manner. Occurs massive, disseminated, globular, and amygdaloid. Dull. Fracture earthy and flat conchoidal. Opaque. Shining in the streak Soft. Sectile. Adheres strongly to the tongue. Feels fine and greasy Sp gr. —2.4. It occurs in trap, porphyry, and serpentine rocks, in Scotland and other countries.

10. *Mountain Soap*.—Colour blackish-brown. Massive. Dull. Fracture earthy. Opaque. Shining in the streak. Writes. Soft. Sectile. Adheres strongly to the tongue. Feels greasy. Occurs in secondary trap rock, in the Island of Skye.

11. *Bole*.—Colours brown, yellow, red, and black. Sometimes spotted and dendritic. Massive, and disseminated. Lustre glimmering. Fracture conchoidal. Feebly translucent. Soft. Feels greasy. Shining streak. Adheres to the tongue. Sp. gr. =1.922. Occurs imbedded in secondary trap-rocks in Scotland.

2. *Rhomboidal Talc-Mica*, or *Common Mica*.—Jameson.

Rhomboedrischer Talk-glimmer, *Mohs*.

Specific Character.—Rhomboidal. Rhomboid unknown. Combination dirhomboidal. Cleavage, R —∞. Elastic. Hardness =2.0, —2.5. Sp. gr. =2.8, —3.0.

Description.—Colours grey, white, brown, black, red, and blue. Occurs regularly crystallized; in granular and prismatic concretions; massive and disseminated. Lustre ranges from splendent to shining; generally pearly, and sometimes semi-metallic. Fracture coarse, splintery, and scaly foliated. Ranges from transparent to feebly translucent. Sectile Streak grey and dull.

The red and blue varieties, and which exhibit the splintery and scaly-foliated fractures, are described under the name *Lepidolite*.

Geognostic and Geographic Situations.—It occurs in all the primitive formations, and in most of those belonging to the transition and secondary classes, and therefore is an abundant mineral in this island. The lepidolite variety is rare; Dalmally may be mentioned as a British locality.

* *Pinite*.—Colours green, more or less deeply iron-shot. Occurs crystallized in six-sided prisms, in lamellar and granular concretions, and massive. Lustre glistening, glimmering, and resinous. Fracture uneven. Opaque. Soft. Sectile, not flexible. Feels rather greasy. Sp. gr. =2.914. Occurs imbedded in porphyry in Ben Gloe, and other mountains in Scotland.

Genus VIII.—Pearl-Mica.

Perl-glimmer, *Mohs*.

Rhomboidal. Hardness, =3.5, —4.5. Sp. gr. =3.0, —3.1.

1. *Rhomboidal Pearl-Mica*.—Jameson.

Rhomboedrischer Perl-glimmer, *Mohs*.

Specific Character.—Rhomboidal. Rhomboid unknown Combination dirhomboidal. Cleavage, R —∞. Streak, white or grey.

Order VI.—Spar.

No metallic lustre. Streak white or grey, . . . and brown. Hardness, =3.5, —7.0. Sp. gr. =2.0, —3.7. If rhomboidal, the sp. gr. =2.2, and less, or the hardness =6.0. If hardness =4.0, the clea-

vage is montomous. If hardness above 6.0, the sp. gr. is under 2.5, or above 2.8; and the lustre is pearly. If sp. gr. above 3.3, the combination is hemi or tetarto-prismatic, or the hardness =6.0; and no adamantine lustre. If sp. gr. =2.4, and less, there are traces of form and cleavage.

Genus I.—Schiller-Spar.

Schiller-Spath, *Mohs*.

Prismatic. Cleavage montomous. Hardness =3.6, —6.0. Sp. gr. =3.6, —3.4. If hardness =6.0, the lustre is metallic-pearly.

1. *Diatomous*, * or *Common Schiller-Spar*.—Jameson.

Diatomer Schiller-spath, *Mohs*.—Schiller-stein, *Werner*.—Diallage Metalloide, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatoidal. Metallic pearly lustre. Hardness =3.5, —4.0. Sp. gr. =2.6, —2.8.

Description.—Colours green, grey, and brown. Occurs in granular concretions; disseminated, and seldom massive. Lustre shining or splendent, and metallic-pearly. Translucent on the edges, or opaque. Dull streak.

Geognostic and Geographic Situations.—Occurs imbedded in serpentine in the Shetland Islands, and in secondary trap-rocks in the middle district of Scotland.

2. *Axotomous* † *Schiller-Spar*, or *Green Diallage*.—Jameson.

Axentheilender Schiller-spath, *Mohs*.—Korniger Strahlstein, *Werner*.—Diallage Verte, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P-\infty$. (Fig. 27) Common pearly lustre. Hardness =4.5, —5.5. Sp. gr. =3.0, —3.2.

Description.—Colour green; massive and disseminated. Internally shining and glistening. Translucent on the edges, or translucent.

Geognostic and Geographic Situations.—Occurs in primitive rocks in Shetland Islands, and Mainland of Scotland.

3. *Hemi-prismatic Schiller-Spar, or Bronzite*.—Jameson.

Hemiprismatischer Schiller-Spath, *Mohs*.—Blättriger Anthophyllite, *Werner*.—Diallage Metalloide, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Combination hemiprismatic. Cleavage, $\frac{P}{2}$. $\breve{P}r+\infty$. Less perfect, $\frac{\bar{P}r}{2}$. $\bar{P}r+\infty$. (Fig. 29, 35, 28.) Lustre metallic-pearly. Hardness =4.0, —5.0. Sp. gr. =3.0,—3.3.

Description.—Colours brown and grey. Occurs in granular concretions. Lustre shining. Cleavage sometimes appears fibrous. Translucent on the edges. Streak white.

Geognostic and Geographic Situations.—Occurs in serpentine in Shetland; in greenstone in the Island of Skye, and near Portsoy; and in other parts of Scotland.

4. *Prismatoidal Schiller-Spar, or Hypersthene*.—Jameson.

Prismatoidischer Schiller-Spath, *Mohs*.—Paulit, *Werner*.—Hypersthene, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $\breve{P}r+\infty$. Less perfect, $P+\infty=100$ (nearly). $\bar{P}r+\infty$. (Fig. 29, 30, 28.) Lustre metallic-pearly. Hardness =6.0. Sp. gr. =3.3, —3.4.

Description.—Colours greenish and greyish black: also copper-red and brown. Occurs in granular and lamellar concretions, and massive. Lustre shining. Opaque or feebly translucent.

Geognostic and Geographic Situations.—Occurs in greenstone in the Island of Skye; also in Banffshire and the Shetland Islands.

5. *Prismatic Schiller-Spar, or Anthophyllite*.—Jameson.

Prismatischer Schiller-Spath, *Mohs*.—Strahliger Anthophyllit, *Werner*.—Anthophyllite, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage. $\breve{P}r+\infty$. Rather less perfect, $P+\infty=106°$ (nearly). $\bar{P}r+\infty$. (Fig. 28, 30, 29.) Lustre almost metallic-pearly. Hardness =5.0—5.5. Sp. gr. =3.0,—3.3.

Description.—Colours yellowish grey and yellowish brown. Occurs crystallized in reed-like crystals; in scopiform and promiscuous radiated concretions, also massive. Translucent on the edges.

Geognostic and Geographic Situations.—Occurs in primitive rocks, near Drumnadrochit, in Inverness-shire.

Genus II.—Kyanite.

Disthen Spath, *Mohs*.

Prismatic. Hardness =5.0, —7.0. Sp. gr. =3.5, —3.7.

1. *Prismatic Kyanite*.—Jameson.

Disthen Spath, *Mohs*—Kyanite and Rhatizit, *Werner*.—Disthene, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Combination, tetarto-prismatic. Cleavage, two faces, the one more distinct than the other. Incidence =102° 50′.

Description.—Colours blue and bluish green. Occurs regularly crystallized; in distinct concretions, which are granular and radiated, which latter are sometimes scopiform and stellular; also massive and

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* From δια, through; and τεμνω, I cut; easily cleavable in one direction.

† From αξων, the axis; and τεμνω, I cut; cleavable perpendicular to the axis.

disseminated. Lustre splendent and pearly. Translucent and transparent.

Geognostic and Geographic Situations.—It occurs in primitive rocks in the Shetland Islands; also in Banffshire and Aberdeenshire.

Genus III.—Spodumene.

Hardness =6.5, —7.0. Sp. gr. =3.0, —3.1.

1. *Prismatic Spodumene.*—Jameson.

Spodumen, *Werner.*—Triphane, *Hauy.*

Specific Character.— Prismatic. Pyramid unknown. Cleavage, $P+\infty=100^{\circ}$ (nearly). Somewhat more distinct, $\breve{P}r+8$. Not blue. (Fig. 30, 29.)

Description.—Colours greenish white and green. Occurs massive, and in large granular concretions. Lustre shining, glistening, and pearly. Fracture uneven. Translucent. Uncommonly easily frangible.

Geognostic and Geographic Situations.—Occurs in primitive rocks in Sweden and in Ireland.

Genus IV.—Prehnite.

Axotomer Triphan-Spath, *Mohs.*—Prehnite, *Werner* and *Hauy.*

Hardness =6, —7. Sp. gr. =2.8, —3.0. Not blue.

1. *Axotomous Prehnite.*—Jameson.

Specific Character.—Prismatic. Pyramid unknown. Cleavage $P+\infty=103^{\circ}$ (nearly). More distinct $P-\infty$. (Fig. 30, 27.)

Description.—Colours green, grey, and white. Occurs crystallized; in granular and in scopiform and stellular fibrous distinct concretions; massive and reniform. Lustre shining, glistening, and pearly. Fracture uneven. Ranges from transparent to translucent.

Geognostic and Geographic Situations.—The more highly crystallized varieties have hitherto been found principally in primitive rocks, while the fibrous or less perfectly crystallized varieties occur principally in secondary trap-rocks. The secondary traprocks of Scotland afford many localities of this mineral.

* *Karpholite.*—The colour of this rare mineral is yellow. It occurs in fine prismatic concretions. Its hardness is unknown, but its sp. gr. =2.935. It has hitherto been found only at Schlackenwalde in Bohemia.

Genus V.—Datolite.

Dystom-Spath, *Mohs.*

Prismatic. Internally, lustre resinous. Colour not blue. Hardness =5.0,—5.5. Sp. gr. =2.9,—3.0.

1. *Prismatic Datolite.*—Jameson.

Prismatischer Dystom-Spath, *Mohs.*—Chaux Boratée Siliceuse, *Hauy.*

Specific Character.—Prismatic. Pyramid $=129^{\circ}\ 1'$; $105^{\circ}\ 2'$; $69^{\circ}\ 23'$. Combination hemiprismatic. $\frac{P}{2}=129^{\circ}\ 1'$. Cleavage, $P+\infty=109^{\circ}\ 28'$ imperfect. (Fig. 30.)

Description.—Most frequent colours white and grey, seldom red, green, and yellow. Occurs regularly crystallized; in granular, scopiform, and stellular, fibrous, and curved lamellar concretions; massive, reniform, and botryoidal. Lustre ranges from shining to dull, and is resinous or pearly. Fracture conchoidal, uneven, and earthy. Ranges from transparent to opaque.

The reniform and botryoidal varieties in fibrous concretions are named *Botryolite;* the earthy-looking and botryoidal *Earthy Botryoidal Datolite;* all the others *Common Datolite.*

Geognostic and Geographic Situations.—Occurs in beds of magnetic iron-ore, subordinate to gneiss, near Arendal in Norway, and rarely in other parts of Europe.

Genus VI.—Zeolite.

Kouphon-Spath, *Mohs.*

Tessular, rhomboidal, pyramidal, prismatic. Hardness =3.5,—6.0. Sp. gr. =2.0—2.5. If the most distinct cleavage be parallel to a rectangular prism, the sp. gr. =2.4, and less.

1. *Trapezoidal Zeolite, or Leucite.*—Jameson.

Trapezoidaler Kuphon-Spath, *Mohs.*—Leuzit, *Werner.*—Amphigène, *Hauy.*

Specific Character.—Tessular. Cleavage hexahedral, dodecahedral, imperfect. Hardness =5.5,—6.0. Sp. gr. =2.4,—2.5.

Description.—Colours white and grey. Occurs regularly crystallized; in granular concretions, and in roundish grains. Lustre shining or glistning, and vitreo-resinous. Fracture flat conchoidal. Ranges from transparent to opaque.

Geognostic and Geographic Situations.—Occurs in imbedded grains and crystals in older lavas, and associated with garnet, hornblende, quartz, glassy felspar, in the ejected masses of Monte Somma, and the extinct volcanoes on the Rhine, afford examples of leucite in both situations.

2. *Dodecahedral Zeolite, or Sodalite.*—Jameson.

Dodecaedrischer Kuphon-Spath, *Mohs,*—Sodalite, *Thomson.*

Specific Character.—Tessular. Cleavage dodecahedral, and perfect. Hardness =5.5,—6.0. Sp. gr. =2.2,—2.4.

Description.—Colour green. Occurs in rhomboidal dodecahedrons, and massive. Lustre shining or glistening, and vitreo-resinous. Fracture conchoidal. Translucent.

Geognostic and Geographic Situations.—Occurs in mica-slate in West Greenland.

3. *Hexahedral Zeolite, or Analcime.*—Jameson.

Hexaedrischer Kuphon-Spath, *Mohs,*—Analcime, *Hauy.*—Kubizit, *Werner.*

Specific Character.—Tessular. Cleavage hexahedral, imperfect. Hardness=5.5. Sp. gr. =2.0,—2.2.

Description.—Colours white and red. Occurs regularly crystallized; in angulo-granular concretions, and massive. Lustre shining, glistening and vitreopearly. Fracture uneven, or conchoidal. Ranges from transparent to translucent.

Geognostic and Geographic Situations.—Occurs in secondary greenstone rocks in Fifeshire, Salisbury Crag, near Edinburgh, and in the same rock in many other parts of Scotland.

4. *Paratomous Zeolite, or Cross-stone.*—Jameson.

Paratomer Kuphon-spath, *Mohs.*—Kreutzstein, *Werner*—Harmotome, *Hauy*

Specific Character.—Prismatic. Pyramid unknown. Cleavage P. $\overset{o}{P}r+\infty$. $\bar{P}r+\infty$. (Fig. 29, 28.) Hardness $=4.5$. Sp. gr. $=2.3,—2.4$.

Description.—Colours white and grey, sometimes also yellow and red. Most frequently in regular crystals, seldom massive. Lustre shining, glistening, and vitreo-pearly. Fracture conchoidal and uneven. Translucent.

Geognostic and Geographic Situations.—Occurs in galena veins in the mines of Strontian in Argyleshire, and in secondary trap-rocks in Dumbartonshire, and other parts of Scotland.

5. *Rhomboidal Zeolite, or Chabasite.*—Jameson.

Rhomboedrischer Kuphon-Spath, *Mohs.*—Chabasie, *Hauy.*—Schabasit, *Werner.*

Specific Character.—Rhomboidal. Rhomboid, $=93°\ 48'$. Cleavage rhomboidal. Hardness $=4.0,—4.5$. Sp. gr. $=2.0,—2.1$.

Description.—Colour white. Occurs regularly crystallized, seldom massive. Externally splendent, internally glistening and vitreous. Fracture conchoidal and uneven. Translucent.

Geognostic and Geographic Situations.—Occurs in various secondary trap-rocks, especially amygdaloid, and is not unfrequent in the trap-rocks of Scotland.

6. *Diatomous Zeolite, or Laumonite.*—Jameson.

Diatomer Kuphon-spath, *Mohs.*—Laumonite, *Werner, Hauy.*

Specific Character.—Prismatic. Pyramid $=129°\ 7'$; $120°\ 48'$; $81°\ 6'$. $P+\infty=98°\ 13'$. Combination hemi-prismatic, $\frac{P}{2}=120°\ 48'$. Cleavage, $\bar{P}r+\infty$. More perfect, $\overset{o}{P}r+\infty$. (Fig. 28, 29.) Hardness unknown. Sp. gr. $=2.3,—2.4$.

Description.—Colour white. Occurs regularly crystallized, and in granular distinct concretions. Lustre shining, glistening, and pearly. When fresh is transparent; but on exposure to the atmosphere it very soon becomes opaque, and so soft as to yield to the pressure of the finger. Uncommonly easily frangible.

Geognostic and Geographic Situations.—This mineral occurs in secondary trap-rocks in various parts of Scotland and Ireland.

7. *Prismatic Zeolite, or Mesotype.*—Jameson.

Prismatischer Kuphon-spath, *Mohs.*—Mesotype, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P+\infty=91°\ 25'$. (Fig. 30.) Hardness $=5.0,—5.5$. Sp. gr. $=2.0,—2.3$.

Description.—Colours white, red, yellow, and yellowish-brown. Occurs regularly crystallized; in distinct concretions which are scopiform and stellular fibrous, granular, and curved lamellar; reniform, coralloidal, in plates and crusts. Lustre ranging from shining to dull, and is pearly. Fracture, in some varieties, coarse earthy. Ranges from nearly transparent to opaque.

The yellow and brown varieties, with striped colour delineations, and in which the fibrous and granular concretions are intersected by lamellar, are named *Natrolite;* those with earthy fracture and very soft, *Pearly zeolite;* while the other varieties are named *Fibrous zeolite.*

Geognostic and Geographic Situations.—Occurs principally in drusy cavities, or in veins in secondary trap-rocks in many places in Scotland. The natrolite is the rarest variety in Scotland.

8. *Prismatoidal Zeolite, or Stilbite.*—Jameson.

Prismatoidischer Kuphon-spath, *Mohs.*—Stilbit, *Hauy.*—Strahl-zeolith. *Werner.*

Specific Character.—Prismatic. Pyramid $=123°\ 33'$; $112°\ 16'$; $93°\ 7'$. $P+\infty=89°\ 22'$. Cleavage, $\overset{o}{P}r+\infty$, very perfect. (Fig. 29.) Hardness $=3.5,—4.0$. Sp. gr. $=2.0.—2.2$.

Description.—Colour white, sometimes grey, yellow, and red. Occurs regularly crystallized; in granular, and in scopiform, and stellular prismatic concretions; also massive and globular. Externally splendent. Internally shining and pearly. Alternates from transparent to translucent.

Geognostic and Geographic Situations.—Occurs abundantly in secondary trap-rocks in many districts in Scotland.

9. *Hemi-prismatic Zeolite.*—Jameson.

Hemi-prismatischer Kuphon-spath, *Mohs* Blätter Zeolith, *Werner.* Stilbite, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Combination, hemiprismatic $\frac{P}{2}$. Cleavage, $\overset{o}{P}r+\infty$, very perfect. (Fig. 29.) Hardness $=3.5,—4.0$. Sp. gr. $=2.0,—2.2$.

Description.—Colours white, grey, red, and brown. Occurs regularly crystallized; in granular and lamellar distinct concretions. Fracture conchoidal. Externally, lustre splendent, shining, and vitreous; internally, shining and pearly. Ranges from transparent to translucent on the edges.

Geognostic and Geographic Situations.—Occurs in drusy cavities in secondary trap-rocks in the Hebrides and Mainland of Scotland.

10. *Pyramidal Zeolite, or Apophyllite.*—Jameson.

Pyramidaler Kuphon-spath, *Mohs.* Albin, *Werner.* Mesotype épointée, *Hauy.*

Specific Character.—Pyramidal. Pyramid unknown. Cleavage, $P-\infty$, very perfect. $[P+\infty]$ imperfect. Hardness $=4.5,—5.0$. Sp. gr. $=2.2,—2.5$.

Description.—Colour white. Occurs regularly crystallized; in straight and curved lamellar distinct concretions; massive and disseminated. Surface of the cleavage strongly iridescent. Externally splendent, but only the terminal planes of the prism pear-

ly; internally glistening and vitreous. Ranges from transparent to translucent.

Geognostic and Geographic Situations.—Occurs in secondary trap-rocks in the Hebrides and other parts of Scotland.

11. *Axotomous Zeolite*, or *Ichthyophthalmite*.

Axotomer Kuphon-spath, *Mohs.* Ichthyophthalm, *Werner.* Apophyllite, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P—∞, very distinct. Less distinct $\breve{P}r+\infty$. $\bar{P}r+\infty$. (Fig. 27, 29, 28.) Hardness = 4.5, —5.0. Sp. gr. = 2.2, —2.5.

Geognostic and Geographic Situations.—Occurs in secondary trap-rocks in Scotland.

Genus VI.—Petalite.

Petalin-spath, *Mohs.*

Prismatic. Hardness = 6.0, —6.5. Sp. gr. = 2.4, —2.5.

1. *Prismatic Petalite.*—Jameson.

Prismatischer Petalin-spath, *Mohs.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P+∞ = 137° 8′. $\breve{P}r+\infty$.

Description.—Colours red and white. Occurs massive; internally glistning, shining, and nearly pearly. Translucent. Brittle, and rather easily frangible.

Geognostic and Geographic Situations.—It has hitherto been found only in the island of Uton in Sudermania, in large masses, containing spodumene, felspar, quartz, mica, tourmaline, and ores of iron, arsenic, and silver.

Genus VII.—Felspar.

Rhomboidal, pyramidal, prismatic. Cleavage not very perfect. Axotomous. Hardness = 5.0, —6.0. Sp. gr. = 2.5, —2.8. If Sp. gr. = 2.7, and more, the cleavage planes are perpendicular to each other.

1. *Rhomboidal Felspar*, or *Nepheline.*—Jameson.

Rhomboedrischer feldspath, *Mohs.* Nepheline, *Hauy* and *Werner.*

Specific Character.—Rhomboidal. R = 131° 49′. Combination, di-rhomboidal. 2 (R) = 152° 44′; 56° 15′. Cleavage, R—∞. R+∞. Hardness = 6.0. Sp. gr. = 2.5, —2.6.

Description.—Colours white and grey. Occurs regularly crystallized, and massive. Externally splendent, internally shining and vitreous. Fracture conchoidal. Translucent, passing into transparent.

Geognostic and Geographic Situations.—Occurs in drusy cavities in granular foliated limestone, with meionite, Vesuvian, pleonaste, rhomboidal garnet, mica, &c. in the ejected masses on Monte Somma, near Naples.

2. *Prismatic Felspar*, or *Common Felspar.*—Jameson.

Prismatischer Feldspath, *Mohs.*

Prismatic. Pyramid = 134° 26′; 126° 52′; 72° 32′. P+∞ = 81° 47′. Combination $\frac{P}{2}$ = 126° 52′. Cleavage, $\frac{\breve{P}r}{2}$. $\breve{P}r+\infty$. Both very perfect. Less distinct, $(\breve{P}r+\infty)^3$ = 120°. Sometimes only one of the faces. (Fig. 44.) Hardness = 6.0. Sp. gr. = 2.5, —2.8.

Description.—Colours white, grey, green, blue, red, and brown; and sometimes with pearly opalescence, and beautiful changeability of colour. Occurs regularly crystallized; in distinct concretions, which are angulo-granular and lamellar; massive and disseminated. Lustre ranges from splendent to glistening, and even to dull, and is vitreo-pearly, or vitreous. Fracture conchoidal, splintery, slaty, and earthy. Ranges from transparent to opaque.

The transparent and translucent white-coloured varieties, with the silvery or pearly opalescence, are named *adularia;* the white and grey transparent varieties usually in small crystals, which are traversed by numerous rents, are named *glassy felspar;* the translucent varieties, with various shades of colour, such as white and red, and rarely blue and green, are the most abundant, and hence are named *common felspar;* the dark-grey varieties, with the beautiful changeability of colour, are named *Labrador felspar,* from the country where they were first found; the feebly translucent compact varieties, with splintery fracture, are named *compact felspar;* the slaty varieties, with feeble lustre and translucency, are named *slaty felspar or clinkstone;* the varieties, in a comparatively loose state of aggregation, and without lustre and transparency, according to their degrees of compactness, are named *porcelain earth, earthy felspar, and claystone.*

Geognostic and Geographic Situations.—Felspar is one of the most abundant minerals in nature, as it occurs in most of the principal rock formations. It abounds in the Alpine districts of Scotland, England, and Ireland, in granite, syenite, gneiss, porphyry, trap, and quartz rocks.

3. *Pyramidal Felspar*, or *Scapolite.*—Jameson.

Pyramidaler Feldspath, *Mohs.*—Meionit, Scapolith, Schmelzstein, *Werner.*—Paranthine, Meionite, Wernerite, Dipyre, *Hauy.*

Specific Character.—Pyramidal. Pyramid = 136° 7′; 63° 48′. Cleavage, P—∞. More perfect, P+∞. [P+∞]. Hardness = 5.0, —5.5. Sp. gr. = 2.5, —2.8.

Description.—Colours white, grey, green, red, and black. Occurs regularly crystallized; in distinct concretions, which are scopiform, fibrous, or radiated, and angulo-granular; massive and disseminated. Lustre ranges from splendent to glimmering, and is pearly, resino-vitreous, and resino-pearly. Fracture conchoidal, uneven. Ranges from transparent to opaque.

The white and more transparent and highly crystallized varieties are named *Meionite*, while the others have received the names *Scapolite, Paranthine, Wernerite, Dipyre, and Schmelzstein.*

Geognostic and Geographic Situations.—The meionite varieties are found in drusy cavities in granular foliated limestone, along with nepheline, augite, mica, pleonaste, garnet, and calcareous spar, on

Monte Somma, near Naples; the scapolite varieties occur in beds of magnetic ironstone and iron pyrites, in gneiss, along with quartz, felspar, mica, hornblende, epidote, garnet, augite, &c. at Arendal, in Norway; also in Sweden, Finland, Saxony, Pyrenees, &c.

* *Elaolite*.—Muschlicher Wernerite, Fettstein, *Werner*. Lythrodes, *Karsten*. Purre grasse, *Hauy*.

Specific Character.—Prismatic. Cleavage, P—∞. $\overset{o}{Pr}+\infty$. Less distinct, $P+\infty$. Hardness, = 5.5, —6.0. Sp. gr. =2.546, —2.618.

Description.—Colours muddy flesh-red and greenish-grey, inclining to blue. Occurs massive. Lustre glistening and resinous. Fracture flat conchoidal, inclining to splintery and uneven. Translucent.

Geognostic and Geographic Situations.—Occurs imbedded in syenite, along with titanite, zircon, and molybdena, at Laurwig, and Friedrichsivarn, in Norway.

Genus VIII.—Augite.

Prismatic. Lustre not metallic-pearly. Hardness =4.5, —7.0. Sp. gr. =2.7, —3.5. If the hardness is above 6.0, the sp. gr. =3.2, and more. If the sp. gr. is under 3.0, the cleavage is very perfect, and in the direction of oblique-angular prisms.

1. *Paratomous Augite*.—Jameson.

Paratomer Augit, *Mohs*.—Augit, *Werner*.—Pyroxene, *Hauy*.

Specific Character.—Prismatic. Pyramid =152° 12′; 120°; 61° 2′. $P+\infty=51°\ 19'$. Combination hemi-prismatic. $\frac{P}{2}=120°$. Cleavage, $(\overset{o}{Pr}+\infty)^3=87°\ 12'$, $\overset{o}{Pr}+\infty$. $\bar{Pr}+\infty$. Sometimes $\frac{P}{2}$. (Fig. 32, 29, 28, 38.) Hardness =5.0, —6.0. Sp. gr. = 3.2, —3.5.

Description.—Colours green, black, and brown; also grey and white. Occurs regularly crystallized; in granular and fibrous concretions; massive and disseminated. Lustre ranges from splendent to glimmering, and is vitreo-resinous, resino-pearly, and resinous. Fracture conchoidal and uneven. Ranges from transparent to translucent on the edges.

Those varieties in which the colours are white and pale green, generally crystallized, with a vitreous external, and pearly internal lustre, and translucent, are named *Diopside, Musite, Alalite*, and by some *Baikalite;* those, again, in which the colours are darker green and muddy grey, less frequently crystallized, but disposed in straight, lamellar, and granular concretions, with a shining, vitreous, or pearly lustre, and translucent on the edges, are named *Sahlite, Pyrogome, Fassaite, Malacolite*, and by some *Baikalite;* other varieties, in which the colours are black and dark green, with conchoidal and uneven fracture, resinous lustre, and opaque or faintly translucent on the edges, are named *Conchoidal Augite and Common Augite;* those varieties in which the colours are principally leek-green and greenish-black, generally in loosely aggregated angulo-granular concretions, with a shining vitreo-resinous lustre, uneven fracture, and ranging from translucent to opaque, are named *Coccolite and Granular Augite;* and, lastly, the fibrous varieties have been described as *Amianthus*.

Geognostic and Geographic Situations.—The diopside varieties are found imbedded in serpentine, and associated with magnetic iron-ore in Piedmont; the sahlite in beds of primitive trap, limestone, and magnetic iron-ore, subordinate to gneiss and mica slate in Scotland, Ireland, and Scandinavia; the conchoidal augite and common augite occur principally in secondary trap rocks; and the coccolite and granular augite in the iron mines of Arendal, in Norway, in gneiss.

2. *Hemi-prismatic Augite, or Hornblende*.—Jameson.

Hemi-prismatischer Augit-spath, *Mohs*.—Hornblende, &c. *Werner*.—Amphibole, *Haüy*.

Specific Character.—Prismatic. Pyramid =151° 8′; 148° 39′; 42° 22′. $P+\infty=87°\ 11'$. Combination, hemi-prismatic, $\frac{P}{2}=148°\ 39'$. Cleavage, $(\overset{o}{Pr}+\infty)^3=124°\ 34'$. Less distinct, $\overset{o}{Pr}+\infty$. $\bar{Pr}+\infty$. (Fig. 32, 29, 28.) Hardness =5.0, — 6.0. Sp. gr. =2.7, —3.2.

Description.—Colours green, white, black, grey, blue, and brown. Occurs regularly crystallized; in fibrous, radiated, and granular distinct concretions. Lustre ranges from splendent to feebly glimmering, and lustre vitreo-pearly, pearly, or vitreous, and vitreo-resinous. Fracture conchoidal, uneven, and slaty. Alternates from transparent to opaque.

The varieties with dark green and black colours, in granular and fibrous concretions, and in which the lustre ranges from splendent to shining, and is pearly or pearly-vitreous, and the transparency from transparent to translucent on the edges, are named *Hornblende and Carinthine;* the varieties with light green, and also greenish-grey, and sometimes brown and yellow colours, rarely crystallized (and then generally in reed-like crystals), more frequently massive, and in radiated, fibrous, and granular concretions, with a pearly or vitreous, splendent, shining, or glistening lustre, and transparency varying from transparent to opaque, are named *Actynolite and Calamite:* the white and blue varieties, disposed in fibrous, radiated, and granular concretions, with a lustre which is shining, or glistening and pearly, or vitreo-pearly, and ranging from translucent to translucent on the edges, are named *Tremolite;* other varieties, in which the colours are white, green, yellow, blue, and brown, and disposed in flexible, shining, silky, fibrous concretions, are named *Flexible Asbestus, or Amianthus;* others, which are of a white colour, or grey colour, and disposed in minute promiscuous fibrous concretions, and so light as to swim in masses in water, are named *Mountain Cork;* those in which the colours are generally green, and disposed in straight, shining, pearly, rigid, fibrous concretions, are named *Rigid, or Common Asbestus;* and, lastly, those varieties in which the colour is wood-brown, and in general aspect much resembling fossil wood, are named *Rock-wood*, or *Ligneous Asbestus*.

Geognostic and Geographic Situations.—The hornblende varieties abound in primitive and transition rocks, and are also met with in those of the secondary class; those named actynolite and tremolite scarcely occur in secondary rocks, being confined principally to those of the primitive class; while the asbestine varieties are principally met with in the serpentine rocks of primitive and transition mountains. Numerous localities of this species occur in Scotland, England, and Ireland.

3. *Prismatoidal Augite, or Epidote.*—Jameson.

Prismatoidischer Augit-spath, *Mohs.*—Epidote, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Combination hemi-prismatic. Cleavage, two faces, of which one is more distinct than the other. Incidence =114° 37'. Hardness =6.0, —7.0. Sp. gr. =3.2, —3.5.

Description.—Colours green and grey. Occurs regularly crystallized; in granular, fibrous, and prismatic concretions. Lustre ranges from splendent to glimmering, and is resino-pearly. Fracture conchoidal, uneven, splintery, and sometimes nearly earthy. Ranges from transparent to translucent on the edges. Brittle, and easily frangible.

The green varieties are named simply epidote, or *pistacite;* while the grey and less perfectly crystallized varieties are named *zoisite.*

Geognostic and Geographic Situations.—It occurs principally in primitive rocks, such as gneiss, mica-slate, syenite, &c. Inverness-shire, Ross-shire, the Shetland Islands, and other parts of Scotland, afford many varieties of it.

4. *Prismatic Augite, or Tabular-Spar.*—Jameson.

Prismatischer Augit spath, *Mohs.*—Schaalstein, *Werner.*—Spath en Tables, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P+ ∞ =105° (nearly). $\overset{\circ}{Pr}+\infty$. $\bar{Pr}+\infty$. Sp. gr. =2.7, —2.9.

Description.—Colour white. Occurs in granular and lamellar concretions; also massive and disseminated. Lustre ranges from shining to glistening, and is pearly-vitreous. Fracture splintery. Translucent. Brittle.

Geognostic and Geographic Situations.—Occurs in primitive rocks in the Bannat, and in rocks of the same description in the island of Ceylon.

Genus IX.—Azure-Spar.

Colour blue. Hardness =5.0,—6.0. Sp. gr. = 3.0, —3.1.

1. *Prismatic Azure-Spar.*—Jameson.

Lazulit, *Werner.*—Lazulite, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage P+ ∞. (Fig. 30.) Colour lively. Hardness =5.0, —5.5.

Description.—Colour blue. Occurs massive. Fracture uneven. Opaque. Very feebly translucent on the edges. Easily frangible.

Geognostic and Geographic Situations.—Occurs imbedded in quartz, in the district of Vorau, in Stiria.

2. *Prismatoidal Azure-Spar.*—Jameson.

Blauspath, *Werner.*—Feldspath, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatoidal. Colour pale. Hardness = 5.5, —6.0.

Description.—Colour blue. Occurs massive and disseminated. Lustre glistening. Fracture splintery. Feebly translucent. Yields a greyish-white streak.

Geognostic and Geographic Situations.—Occurs in primitive rocks in Stiria.

* 1. *Azure-Stone, or Lapis Lazuli.*

Lazurstein, *Werner.*

Tessular. Form dodecahedral. Cleavage unknown, imperfect. Azure blue. Hardness =5.5, —6.0. Sp. gr. =2.767, —2.959.

Colour blue. Occurs massive, with disseminated marble and iron pyrites. Lustre glistening and glimmering. Fracture uneven. Feebly translucent on the edges.

Geognostic and Geographic Situations.—Occurs in rocks of limestone in Persia and China.

2. *Hauyne-Latialite.*—Haüy.

Prismatic. Cleavage P. More distinct P—∞, Blue. Scratches glass. Sp. gr. =2.687, Gmelin. 3.333, Gismondi.

3. *Calaite or Mineral Turquois.*

Form unknown. Massive. Blue...green. Streak white. Hardness =6. Sp. gr. =2.830....3.0.

4. *Amblygonite.*—Breithaupt and Mohs.

Prismatic. P+∞ =106° 10'. Cleavage, P+∞. Hardness =6. Sp. gr. =3.0.

5. *Diaspore.* Diaspore.—*Haüy and Mohs.*

Prismatic. Cleavage, P+∞. =130° nearly. More distinct $\overset{\circ}{Pr}+\infty$. Scratches glass. Sp. gr. =3.433.

6. *Gehlenite.* Gehlenit.—*Mohs and Haüy.*

Pyramidal, or prismatic. Cleavage unknown, or very imperfect. Hardness =5.5. —6. Sp. gr. =2.0, —3.1.

Order VII.—Gem.

No metallic lustre. Streak white or grey. Hardness =5.5,—10.0. Sp. gr. =1.9,—4.7. If hardness =6.0, and less, the sp. gr. =2.4, and less, and no traces of form or cleavage. If sp. gr. is less than 3.8, there is no pearly lustre.

Genus I.—Andalusite.

Prismatic. Cleavage, not prismatoidal. Hardness =7.5. Sp. gr. =3.0,—3.2.

1. *Prismatic Andalusite.*—Jameson.

Prismatischer Andalusit, *Mohs.*—Andalusit, *Werner.*—Feldspath apyre, *Haüy.*

Specific Character. — Prismatic. Pyramid unknown. Cleavage, P+∞. $\overset{\circ}{Pr}+\infty$. $\bar{Pr}+\infty$. (Fig. 30, 29, 28.)

Description.—Colours red and grey. Occurs re-

 gularly crystallized and massive. Lustre shining, glistening, and vitreous. Fracture uneven. Feebly translucent.

Geognostic and Geographic Situations.—Occurs in gneiss in Shetland Islands, and in Aberdeenshire.

* *Fibrolite.*—Bournon.

Prismatic. P+∞ =100°. Cleavage imperfect. Hardness more considerable than quartz, and sp. gr. =3.214. Occurs in the Carnatic.

* *Chiastolite.* Hohlspath, *Werner.*—Macle, *Haüy.*

Prismatic. P+∞ =84°48. $\bar{Pr}$ = 120 nearly.

Cleavage, P—∞. $\breve{Pr}$+∞. $\bar{Pr}$+∞. All of them imperfect. Hardness =5,—5.5. Sp. gr. =2.9,—3.0. Occurs in clay-slate near Keswick in Cumberland, and near Balahulish in Argyllshire.

Genus II.—Corundum.

Tessular, rhomboidal, prismatic. Hardness =8.0.—9.0. Sp. gr. =3.5, —4.3. If prismatic, the sp. gr. =3.7, and more, and hardness =8.5. If colour red, and sp. gr. =3.7, and more, the hardness =9.0.

1. *Dodecahedral Corundum.*—Jameson.

Dodecaedrischer Corund, *Mohs.*—Spinel and Zeilanit, *Werner.*—Spinelle, *Haüy.*

Specific Character.—Tessular. Cleavage, octahedral, but obtained with difficulty. Hardness =8.0. Sp. gr. 3.5, —3.8.

Description.—Colours red, and sometimes green, black, blue, yellow, brown, and white. Occurs regularly crystallized. Lustre splendent and vitreous. Fracture conchoidal. Ranges from transparent to translucent on the edges.

The dark green and black varieties, which are only translucent on the edges, are named *ceylanite;* and all the others *spinel* or *spinel-ruby.*

Geognostic and Geographic Situations.—The ceylanite varieties occur in the sand of rivers in Ceylon; the others also in Ceylon, Pegu, and other countries.

2. *Octahedral Corundum or Automalite.*—Jameson.

Octaedrischer Corund, *Mohs.*—Automalite, *Werner.*—Spinelle Zincifere, *Haüy.*

Specific Character.—Tessular. Cleavage, octahedral, and easily obtained. Hardness =8. Sp. gr. =4.1, —4.3.

Description.—Colour green. Occurs regularly crystallized. External lustre pearly, inclining to semi-metallic, internally shining and resinous. Fracture conchoidal. Opaque or faintly translucent on the edges.

Geognostic and Geographic Situations.—Occurs imbedded in talc, and associated with lead-glance at Fahlun in Sweden.

3. *Rhomboidal Corundum.*—Jameson.

Rhomboedrischer Corund, *Mohs.*

Specific Character.—Rhomboidal. Rhomboid =86° 6′. Cleavage R—∞. More perfect R. Hardness =9.0. Sp. gr. =3.8, —4.3.

Description.—Colours blue, red, grey, white, green, yellow, brown, and black. Occurs regularly crystallized and massive. Lustre ranges from splendent to glimmering, and vitreous, or vitreous sometimes inclining to adamantine. Fracture conchoidal and uneven. Ranges from transparent to feebly translucent on the edges.

The transparent blue varieties are named *sapphire;* the transparent red varieties, *oriental ruby;* the massive, nearly opaque, grey and black varieties, *emery;* the translucent, massive, and crystallized varieties, *common corundum;* and the brown faintly translucent varieties, *adamantine spar.*

Geognostic and Geographic Situations.—The finest sapphires and oriental rubies are found in alluvial soil in Ceylon and Pegu, and other countries; the emery occurs in primitive talc-slate in Saxony; the common corundum and adamantine spar in granite, syenite, and other rocks in India and China.

4. *Prismatic Corundum, or Chrysoberyl.*—Jameson.

Prismatischer Corund, *Mohs.*—Krysoberyll, *Werner.*—Cymophane, *Haüy.*

Specific Character.—Prismatic. Pyramid =139° 53′; 86° 16′; 107° 29′. P+∞ =128° 35′. Cleavage =$\breve{Pr}$+∞. Less perfect Pr+∞. (Fig. 29, 28.) Hardness =8.5. Sp. gr. =3.7, —3.8.

Description.—Colour green, and often exhibits a milk-white opalescence. Occurs regularly crystallized, and in blunt edged pieces. Lustre splendent and resino-vitreous. Fracture conchoidal. Semi-transparent and transparent.

Geognostic and Geographic Situations.—Occurs imbedded in granite veins in America, and in alluvial soil in Ceylon.

Genus III.—Diamond.

Tessular. Hardness =10. Sp. gr. =3.4,—3.6.

1. *Octahedral Diamond.*—Jameson.

Specific Character.—Tessular. Cleavage octahedral.

Description.—Its colours are more numerous than that of most other minerals, and of the various tints the grey and white are the most frequent; and it exhibits beautiful red, yellow, and blue varieties. Occurs regularly crystallized, and in roundish grains. The lustre splendent and adamantine. Fracture conchoidal. Transparent and semi-transparent.

Geognostic and Geographic Situations.—It has hitherto been found principally loose in alluvial soil, in the warmer regions of the earth, as Brazil, Borneo, and the Peninsula of India.

Genus IV.—Topaz.

Prismatic. Cleavage axotomous. Hardness =8. Sp. gr. =3.4,—3.6.

1. *Prismatic Topaz.*—Jameson.

Prismatischer Topaz, *Mohs.*—Topaz. Physalit. Piknit, *Werner.*—Silice Fluatée Alumineuse, *Haüy.*

Specific Character.—Prismatic. Pyramid =141° 7′; 101° 52′; 90° 55′. P+∞ =124° 19′. Combination, sometimes with different planes on opposite ends. Cleavage, P+∞. (Fig. 27.)

Description.—Colours yellow, green, blue, red,

grey, white. Occurs regularly crystallized; also in prismatic and granular concretions, and massive. Lustre ranges from splendent to glistening, and is vitreous and resinous. Fracture conchoidal and uneven. Ranges from transparent to translucent on the edges. Easily and uncommonly easily frangible.

The highly crystallized and transparent varieties are named *precious topaz;* those in prismatic distinct concretions, with a slight degree of translucency on the edges, and which are uncommonly easily frangible, *schorlous topaz;* and those in coarse granular concretions, with a low degree of lustre, and feeble translucency on the edges, *physalite.*

Geognostic and Geographic Situations.—Precious topaz occurs in alluvial soil in the upper parts of Aberdeenshire, and in primitive rocks in Cornwall; schorlous topaz is said also to occur in Aberdeenshire; and the physalite in granite, at Finbo in Sweden.

Genus V.—Emerald.

Rhomboidal. Prismatic. Cleavage rhomboido-axotomous and peritomous, or prismatoidal. Hardness =7.5, 8.0. Sp. gr. =2.6, —3.2.

1. *Prismatic Emerald, or Euclase*—Jameson.

Euclas, *Werner.*—Prismatischer Smaragd, *Mohs.*—Euclase, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. $P+\infty=133^\circ\ 26'$. Combination, hemi-prismatic. $\frac{P}{2}$. Cleavage, $\bar{P}r+\infty$. Very distinct. Hardness =7.5. Sp. gr. =2.9, —3.2.

Description.—Colours green, white, and blue. Occurs regularly crystallized. Lustre splendent. Fracture conchoidal. Transparent and translucent. Very easily frangible.

Geognostic and Geographic Situations.—This beautiful and rare mineral has been hitherto found only in Peru and Brazil.

2. *Rhomboidal Emerald.*—Jameson.

Rhomboedrischer Smaragd, *Mohs.*—Emeraude, *Hauy.*

Specific Character.—Rhomboidal, $R=104^\circ\ 28'$. Combination di-rhomboidal. $2\ (R)=138^\circ\ 35' : 90$. Cleavage, $R-\infty$. Less perfect, $P+\infty$. Hardness =7.5, —8.0. Sp. gr. =2.6, —2.8.

Description.—Colours green, blue, yellow, and grey. Occurs regularly crystallized, and in thin prismatic concretions. Lateral planes longitudinally streaked or smooth. Lustre ranges from splendent to glistening, and is vitreous. Fracture conchoidal. Ranges from transparent to translucent on the edges. Easily frangible.

The varieties, with emerald-green colours, and, in short, smooth, transparent, and translucent prisms, with rough terminal planes, are named *precious emerald,* while the others, in which the colours are green, blue, yellow, and grey, and crystallized in long longitudinally streaked prisms, are named *beryl,* or *common emerald.*

Geognostic and Geographic Situations.—The precious emerald is found in mica-slate, and clay-slate, and the finest varieties are those imported from Peru. The beryl, or common emerald, occurs in Aberdeenshire; but nearly all the varieties, met with in trade, are brought from Russia.

Genus VI.—Quartz.

Rhomboidal, prismatic. Cleavage not axotomous. Hardness =5.5, —7.5. Sp. gr. =1.9, —2.7.

1. *Prismatic Quartz, or Iolite.*—Jameson.

Prismatischer Quarz, *Mohs.*—Iolith. Peliom, *Werner.*—Iolithe, *Hauy.*—Dichroite. Steinheilite, *Auct.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P+\infty=120^\circ$ (nearly). $\overset{o}{P}r+\infty$ (Fig. 30, 29.) Hardness =7.0, —7.5. Sp. gr. =2.5, —2.6.

Description.—Colour blue. Of an indigo blue colour, when viewed in the direction of the axis, but viewed perpendicular to the axis, is brownish yellow. Occurs rarely crystallized, generally massive and disseminated. Lustre shining and vitreous. Fracture uneven and conchoidal. Translucent in the direction of the axis, and transparent at right-angles to it.

Geognostic and Geographic Situations.—Occurs in granite, gneiss, and it is said also in volcanic tuffa; Abo in Finland, Arendal in Norway, St Gothard in Switzerland, and Granatillo in Spain, are localities of this mineral.

2. *Rhomboidal Quartz.*—Jameson.

Quartz, *Werner.*—Rhomboedrischer Quarz, *Mohs.*

Specific Character.—Rhomboidal. Rhomboid = $75^\circ\ 47'$. Combination, hemi-rhomboidal and hemi-dirhomboidal. $R+n$ and $(P+n')^m$, with inclined planes, and $P+n''$ with parallel planes. Cleavage, $P=133^\circ\ 38'$; $103^\circ\ 53'$. $P+\infty$. Hardness =7.0. Sp. gr. =2.5, —2.7.

Description.—Colours white, grey, rarely black, blue, green, yellow, red, and brown. Occurs regularly crystallized; in granular, fibrous, prismatic, and lamellar concretions; also massive, disseminated, in plates, stalactitic, reniform, botryoidal, globular, specular, vesicular, and cellular. Lustre ranges from splendent to glimmering, and is vitreous. Fracture conchoidal, even, uneven, and splintery. Ranges from transparent to opaque. Brittle, and easily frangible.

The transparent and highly crystallized varieties are named *rock crystal.* The pyramidal, translucent, and transparent varieties, having generally a violet blue colour, and disposed in prismatic, fibrous, and lamellar concretions, are named *amethyst.* The massive, strongly translucent, rose-red, and milk-white varieties, are named *rose quartz.* Those varieties which have generally grey or white colours, the pyramidal form, and occur massive, disseminated, and in the various particular external forms enumerated above, with a low degree of lustre and translucency, are named *common quartz.* The leek-green translucent varieties, with a resino-vitreous lustre, and conchoido-splintery fracture, are named *prase.* The *cat's eye* is a variety, with a beautiful opalescence, like the light of the eye of the cat. Those opaque varieties, in which the colours are red, brown, and yellow, and the lustre shining externally, and glist-

ening internally, and vitreo-resinous, and fracture small conchoidal, are named *iron-flint*. Those varieties which exhibit grey, yellow, brown, red, and green, generally muddy colours, and which occur massive and in extraneous external shapes, with a splintery, or conchoidal, and dull, or glimmering fracture, and are opaque or translucent on the edges, are named *hornstone*. The grey, brown, and black varieties which generally occur massive, and in various particular and extraneous external forms, and exhibit a glimmering lustre, conchoidal fracture, and feeble translucency, are named *flint*. The semi-transparent and translucent varieties, in massive and various particular external forms, with an even and dull fracture surface, are named *common calcedony*. The beautiful apple-green strongly translucent varieties are named *chrysoprase*. The grass-green varieties, with glimmering lustre, conchoidal fracture, and strong translucency, are named *plasma*. The semi-transparent and strongly translucent varieties, with glistening or shining vitreous lustre and conchoidal fracture, and with various tints of red, brown, yellow, green, and white, are named *carnelian*. The beautiful variety, named *heliotrope*, is well characterized, on a general view, by its green colour, and disseminated spots of red and yellow jasper. Those varieties, in which the colours are red, brown, and black, and seldomer yellow or green, which occur massive and disseminated, with a fracture ranging from conchoidal to earthy, and lustre from glistening to dull, and are opaque, are named *jasper*. And, lastly, the white and grey varieties, which are so porous and light, as to swim on the surface of water, are named *spongiform quartz*, or *floatstone*.

Geognostic and Geographic Situations.—Quartz is very universally distributed, and, as far as we know at present, is the most abundant mineral in nature. It occurs in every rock, from granite to the newest secondary formation; and every country, every district in the world, afford examples of this mineral.

3. *Uncleavable Quartz*.—Jameson.

Untheilbarer Quartz, *Mohs*.

Specific Character.— Reniform.... Massive. No cleavage. Hardness $=5.5$, -6.5. Sp. gr. $=1.9$, -2.2.

Description.—Colours white and grey, also green, yellow, brown, red, and black, and sometimes displays a beautiful play of colour. Occurs massive, and in various particular external forms. Lustre ranges from splendent to glistening, and is vitreous, or vitreo-resinous. Ranges from transparent to opaque.

The grey and white varieties, with glistening and shining pearly lustre, and translucent on the edges, or translucent in the mass, are named *quartzy sinter*, or *pearl sinter*. The yellowish and greyish white varieties with the botryoidal and other particular external forms, conchoidal fracture and vitreous lustre, and which are strongly translucent, are named *hyalite*. The milk-white varieties, with the beautiful play of various rich and pure colours, are named *precious opal*. The transparent varieties, with the beautiful carmine-red and apple-green iridescence, are named *fire opal*. Those varieties which are milk-white, and frequently dendritic, with a pearly, shining, or glistening lustre, conchoidal fracture, and complete opacity, are named *mother-of-pearl opal*, or *cacholong*. The *common opal* differs from the precious, principally in wanting the play of colour. The feebly translucent varieties, with conchoidal fracture, and glistening vitreo-resinous lustre, and white, grey, and brown colours, are named *semi-opal*. Those varieties, in which the colours are red, yellow, and grey, with a shining vitreo-resinous lustre, conchoidal fracture, and opacity, are named *jasper-opal*. Those varieties which occur in various vegetable forms, and are really vegetables impregnated, or petrified with opal, are named *wood-opal*. And, lastly, the brown and yellowish grey tuberose varieties are named *menilite*.

Geognostic and Geographic Situations.—This species has a comparatively limited geognostic and geographic distribution. The quartzy sinter occurs in the vicinity of hot-springs, as in Iceland and other countries; the hyalite in secondary trap-rocks in Scotland, Germany; and the various opals are found principally in secondary trap, and in porphyry rocks in Hungary, Germany, Scotland, and other countries.

4. *Fusible Quartz*.—Jameson.

Empyrodox Quartz, *Mohs*.

Specific Character.—In grains.... Massive. No cleavage. Hardness $=6.0$, -7.0. Sp. gr. $=2.2$, -2.4.

Description.—Colours black, green, and grey; also brown, blue, red, yellow, and white. Occurs in globular, lamellar, and prismatic concretions; massive, vesicular, and porous. Lustre ranges from splendent to glimmering, and is vitreous, resinous and pearly. Ranges from transparent to opaque.

The varieties, with splendent and vitreous lustre, conchoidal fracture, and ranging from transparent to translucent on the edges, are named *obsidian*; those again in which the lustre is shining and resinous, and translucent on the edges, are named *pitchstone*; the beautiful varieties in globular and concentric lamellar, shining, pearly, translucent concretions, are named *pearlstone*; and lastly, the white and grey varieties, which are vesicular and fibrous, with a vitreous or pearly lustre, and often so light as to swim on water, are named *pumice*.

Geognostic and Geographic Situations.—All the minerals of this series are, by some, said to be of volcanic origin, by others to have a double origin, in some cases being volcanic, in others of Neptunian formation. The pitchstone abounds in Scotland, in the Island of Arran, also in the Isle of Egg, in Rum, Skye, and other quarters; pearlstone occurs in great beauty in Hungary and Iceland, and both pumice and obsidian are productions of Iceland, the Lipari Islands, and of other districts, said to be of volcanic origin.

Genus VII.—Axinite.

Perfect vitreous lustre. Hardness $=6.5$, -7.0. Specific gravity $=3.0$, -3.3.

1. *Prismatic Axinite*.—Jameson.

Prismatischer Axinit, *Mohs*.—Thumerstein, *Werner*.—Axinite, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown.

Combination, tetarto-prismatic. Cleavage, two faces, the one more distinct than the other. Incidence = 101° 30′.

Description.—Colours brown, blue, and sometimes grey and black. Occurs regularly crystallized; in curved lamellar concretions, and massive. Lustre externally splendent, internally glistening, or shining, and vitreous. Ranges from transparent to feebly translucent. Brittle, and very easily frangible.

Geognostic and Geographic Situations.—Occurs in beds and veins in gneiss, mica-slate, clay-state, and hornblende-slate. It occurs in small quantities in Cornwall, but no where else in Great Britain.

Genus VIII.—Chrysolite.

Perfect vitreous lustre. Hardness =6.5, —7.0. Sp. gr. =3.3, —3.5.

1. *Prismatic Chrysolite.*—Jameson.

Prismatischer Krisolith, *Mohs.*—Peridot, *Haüy.*

Specific Character.—Prismatic. Pyramid =107° 46′; 101° 31′; 119° 41′. P+∞ =94° 3′. Cleavage, $\breve{P}r+\infty$. Less distinct $\bar{P}r+\infty$. (Fig. 29, 28.)

Description.—Colour green. Occurs regularly crystallized. Lustre splendent and vitreous. Fracture conchoidal. Transparent.

The varieties in granular distinct concretions, and which have a lower degree of transparency and lustre than the more highly crystallized kinds, are those generally described under the name *olivine.*

Geognostic and Geographic Situations.—The mineral occurs principally in secondary trap-rocks, and in alluvial strata. The olivine variety is not unfrequent in some of the middle and western districts of Scotland. The chrysolites of commerce are brought from the Brazils and Upper Egypt.

Genus IX.—Boracite.

Tessular. Hardness =7. Sp. gr.=2.8,—3.0.

1. *Octahedral Boracite.*—Jameson.

Octaedrischer Borazit, *Mohs.*—Borazit, *Werner.*—Magnesie Boratée, *Haüy.*

Specific Character.—Tessular. Combination, semi-tessular of inclined planes. Cleavage, imperfect.

Description.—Colours white and grey. Occurs regularly crystallized. Internally shining and adamantine. Fracture conchoidal. Translucent and transparent.

Geognostic and Geographic Situations.—Occurs imbedded in secondary gypsum, in Hanover and Holstein.

Genus X.—Tourmaline.

Rhomboidal. Hardness =7.0,—7.5. Sp. gr. = 3.0,—3.2.

1. *Rhomboidal Tourmaline.*—Jameson.

Rhomboedrischer Turmaline, *Mohs.*—Tourmaline, *Haüy.*

Specific Character.—Rhomboidal. Rhomboid = 133° 26′. Combination, with different planes on opposite extremities. Cleavage, R. P+∞.

Description.—Colours black, brown, green, blue, red, and white. Occurs regularly crystallized; in prismatic and granular distinct concretions, massive and disseminated. Lustre ranges from splendent to glistening, and is vitreous. Fracture conchoidal and uneven. Ranges from transparent to opaque. Brittle and easily frangible.

The black coloured opaque varieties, with uneven fracture, are named *schorl*; all the others are ranged under the title *tourmaline.*

Geognostic and Geographic Situations.—It occurs imbedded in granite, gneiss, mica-slate, talc-slate, chlorite slate, dolomite, topaz-rock, and quartz-rock; also in felspar, mica, talc, &c. and in alluvial strata. The schorl varieties occur in various primitive rocks in the Alpine districts of Scotland, and the purer varieties, or tourmaline, properly so called, are met with in Siberia, Spain, and many other countries.

Genus XI.—Garnet.

Tessular, pyramidal, prismatic. Lustre not pure vitreous. Hardness =6.0,—7.5. Sp. gr.=3.0.—4.3. If colour red, the sp. gr. =3.7, and more. If black, sp. gr. =3.9, and less. If hardness, 7.5, the colour is red or brown.

1. *Pyramidal Garnet, or Vesuvian.*—Jameson.

Pyramidaler Granat, *Mohs.*—Vesuvian, and Egeran, *Werner.*—Idocrase, *Haüy.*

Specific Character.—Pyramidal. Pyramid =129° 29′; 74° 14′. Cleavage, P—∞. P+∞. [P+∞]. Hardness =6.5. Sp. gr. =3.3,—3.4.

Description.—Colours green and brown, and rarely blue. Occurs regularly crystallized; in granular distinct concretions, massive, and disseminated. Externally splendent, and internally feebly shining and vitreo-resinous. Fracture uneven, inclining to small conchoidal. Ranges from transparent to translucent in the edges.

Geognostic and Geographic Situations.—Occurs in primitive rocks in Ireland, also in Scotland; and on the continent of Europe the most beautiful varieties are there found in the unaltered ejected masses in Somma, near Naples, where they are associated with granular limestone, garnet, hornblende, mica, chlorite, augite, meionite, nepheline, magnetic iron-ore, &c.

2. *Tetrahedral Garnet, or Helvine.*—Jameson.

Helvin, *Werner.*—Tetraedrischer Granat, *Mohs.*

Specific Character.—Tessular. Combination, semi-tessular of inclined planes. Cleavage, octahedral, but imperfect. Hardness =6.0,—6.5. Sp. gr. =3.1,—3.3.

Description.—Colours yellow, green, and brown. Occurs regularly crystallized, and in granular distinct concretions. Lustre ranges from splendent to glistening and vitreo-resinous. Fracture uneven. Translucent.

Geognostic and Geographic Situations.—Occurs in a bed in gneiss, associated with fluor-spar, slate-spar, chlorite, quartz, blende, and copper-pyrites, near Schwarzenberg, in Saxony.

3. *Dodecahedral Garnet.*—Jameson.

Specific Character.—Tessular. Cleavage dodeca-

 hedral imperfect. Hardness $=6.5,—7.5$. Sp. gr. $=3.5,—4.3$.

Description.—Colours red, brown, green, black, grey, and yellow. Occurs regularly crystallized; in angulo-granular concretions, and massive. Lustre ranges from splendent to glimmering, and is vitreous inclining to resinous, resino-vitreous, and resino-adamantine. Fracture conchoidal, splintery, uneven. Ranges from transparent to opaque.

The asparagus-green varieties in leucite formed crystals are named *grossulare*; the greyish-black dodecahedral opaque varieties, which externally have a metallic-like aspect, *pyreneite*; the velvet-black, dodecahedral, opaque varieties, *melanite*; the green, brown, and grey massive varieties, with glimmering lustre, and feeble translucency on the edges, *allochroite*; the brown and red varieties in granular concretions, with resino-adamantine lustre, *colophonite*; the red highly crystallized transparent varieties, *precious garnet*; the yellow nearly transparent varieties *topazolite* or *yellow garnet*; the brown and green varieties, in crystals often rounded on the edges, in granular concretions, and translucent, or translucent on the edges, *common garnet*; and lastly, the deep blood-red variety in roundish and angular grains, and completely transparent, *pyrope*.

Geognostic and Geographic Situations.—This mineral occurs principally in primitive rocks, either disseminated through them, or forming any ingredient in the composition of subordinate beds; it is comparatively rare in transition rocks, and is still less frequently met with in secondary formations. In Scotland the precious garnet is common in several Highland districts in Perthshire, Aberdeenshire, &c.; and the pyrope variety occurs in secondary trap-rocks in Fifeshire.

4. *Prismatic Garnet, or Cinnamon-Stone.*—Jameson.

Prismatischer Garnet, *Mohs.*—Kaneelstein, *Werner.*—Essonite, *Haüy.*

Specific Character.—Prismatic. (Fig. 30.) Pyramid unknown. Cleavage, $P+\infty=102°\ 40'$, indistinct. Hardness $=7.0,—7.5$. Sp. gr. $=3.5,—3.7$.

Description.—Colour intermediate between hyacinth-red and orange-yellow. Occurs in granular distinct concretions, and massive. Lustre shining and resino-vitreous. Fracture conchoidal. Transparent and translucent.

Geognostic and Geographic Situations.—Occurs in gneiss in Kincardineshire; the finer varieties are imported from Ceylon, where they are found in the beds rivers, and also associated with gneiss.

5. *Prismatoidal Garnet, or Grenatite.*—Jameson.

Prismatoidischer Granat, *Mohs.*—Granatit, *Werner.*—Staurotide, *Haüy.*

Specific Character.—Prismatic. Pyramid $=131°\ 54'$; $80°\ 48'$; $124°\ 48'$. $P+\infty=129°\ 30'$. Cleavage, $\breve{P}r+\infty$, perfect. (Fig. 29.) Hardness $=7.0,—7.5$. Sp. gr. $=3,3,—3.9$.

Description.—Colour reddish brown. Occurs regularly crystallized. Internally the cleavage is shining and splendent; fracture glistening and glimmering, and resino-vitreous, Fracture uneven. Ranges from semi-transparent to opaque.

Geognostic and Geographic Situations.—Occurs in primitive rocks in the Shetland Islands and in Aberdeenshire, and other parts of Scotland.

* *Aplome.*—Colour dark brown. Tessular. Cleavage, hexahedral. Hardness $=7$. Sp. gr. $=3.446$.

** *Eudialite.*—Colour brownish red. Rhomboidal, $R=62°$. Cleavage, $R-\infty$. Less distinct, $P+\infty$. Hardness $=5.0,—5.5$. Sp. gr. $=2,8,—3.0$. Its native country is West Greenland.

Genus XII.—Zircon.

Pyramidal. Hardness $=7.5$. Sp. gr. $=4.5,—4.7$.

1. *Pyramidal Zircon.*—Jameson.

Pyramidaler Zircon, *Mohs.*

Specific Character.—Pyramidal. Pyramid $=123°\ 19'$; $84°\ 20'$. Cleavage, P. $P+\infty$.

Description.—Colours grey and hyacinth red; also white, green, brown, and rarely yellow, blue, and red. Occurs regularly crystallized. Lustre splendent, shining, and adamantine-resinous and resino-vitreous. Fracture conchoidal. Ranges from transparent to opaque.

Those varieties in which the cleavage is very distinct, and which have frequently a hyacinth red colour, are named *hyacinth*, the other varieties *common zircon*.

Geognostic and Geographic Situations.—Occurs in syenite, granite, gneiss, primitive trap, in secondary trap, and unaltered ejected masses of Somma. The syenite rocks of Galloway, the gneiss rocks of Inverness-shire and of the Shetland Islands, afford examples of this mineral.

Genus XIII.—Gadolinite.

Prismatic. Colour black. Hardness $=6.5,—7.0$. Sp. gr. $=4.0,—4.3$.

1. *Prismatic Gadolinite.*—Jameson.

Prismatischer Gadolinit, *Mohs.*

Specific Character.-Prismatic. Pyramid unknown. $P+\infty=110°$ (nearly). Combination, hemiprismatic.

Description.—Colour black, and rarely hyacinth red. Occurs in granular and prismatic concretions, and massive. Internally shining, and lustre, resino-vitreous. Fracture conchoidal, seldom uneven. Opaque.

Geognostic and Geographic Situations.—Occurs in beds of felspar, in mica-slate at Ytterby, and in granite at Finbo, in Sweden.

Order VIII.—Ore.

Hardness $=2.5, \ldots 7$. Sp. gr. $=3.4,—7.4$. If the lustre is metallic, the colour is black. If the lustre is not metallic, it is adamantine or imperfect, or semi-metallic lustre. If the streak is yellow or red, the hardness $=3.5$, and more, and the sp. gr. $=4.8$, and more. If the streak is brown or black, the hardness $=5.0$, and more, or the cleavage montomous. If the hardness $=4.5$, and less, the streak is yellow, red, or black. If hardness $=6.5$, and more, the streak is white or grey, and the sp. gr. $=6.5$, and more.

Genus I.—TITANIUM-ORE.

Pyramidal, prismatic. Hardness =5.0, —6.5. Sp. gr. =3.4, —4.4. If sp. gr. less than 4.2, the streak is white or grey.

1. *Prismatic Titanium-Ore, or Sphene.*—Jameson.

Prismatisches Titan-erz, *Mohs.*—Titane Siliceo-calcaire, *Hauy.*

Specific Character.—Prismatic. Pyramid =111° 12′; 88° 47′; 131° 16′. P+∞ =103° 20′. Combination, hemiprismatic. $\frac{P}{2}$=111° 12′. Cleavage, $\frac{P}{2}$. (Fig. 37.) Streak white or grey. Hardness = 5.0, —5.5. Sp. gr. =3.4, —3.6.

Description.—Colours brown, yellow, green, grey, and white. Occurs regularly crystallized; in granular and lamellar distinct concretions, and massive. Lustre ranges from splendent to glistening, and is adamantine. Fracture conchoidal. Ranges from transparent to opaque.

One set of varieties, in which brown is the predominating colour, is named *common sphene*, or *brown titanium-ore;* and another, in which the principal colours are yellow, and the cleavage distinct, is named *yellow titanium-ore*, or *foliated sphene.*

Geognostic and Geographic Situations.—This mineral occurs imbedded in syenite in Inverness-shire, Perthshire, Galloway, and many other quarters of Scotland; it also occurs in syenite rocks in England.

2. *Peritomous Titanium-Ore, or Rutile.*—Jameson.

Peritomes Titan-erz, *Mohs*—Titan-oxydé, *Hauy.*—Rutil, *Werner.*

Specific Character.—Pyramidal. Pyramid =117° 2′; 95° 13′. Cleavage, P+∞. [P+∞]. Streak brown. Hardness =6.0, —6.5. Sp. gr. =4.2, —4.4.

Description.—Colours brown, red, yellow, and sometimes nearly velvet black. Occurs regularly crystallized, massive, disseminated, in angular grains and in flakes. Lustre metallo-adamantine and adamantine, and ranges from splendent to glistening. Fracture conchoidal. Ranges from transparent to opaque.

The dark-brown and black opaque varieties are named *nigrine;* the others *rutile.*

Geognostic and Geographic Situations.—The rutile varieties occur in the granite of Cairngorm; at Killin, and in Ben-Gloe, in quartz rock. The nigrine varieties are met with at Ely, in Fifeshire, and also in Bohemia and Transylvania.

3. *Pyramidal Titanium, or Octahedrite.*—Jameson.

Pyramidales Titan-erz, *Mohs.*—Octaedrit, *Werner.*—Titane, Anatase, *Haüy.*

Specific Character.—Pyramidal. Pyramid =97° 38′; 137° 10′. Cleavage, P—∞.P. Streak white. Hardness =5.5, —6.0. Sp. gr. =3.8, —3.9.

Description.—Colours blue and brown. Occurs regularly crystallized. Lustre splendent and adamantine, inclining to semi-metallic. Translucent and transparent.

Geognostic and Geographic Situations.—Occurs in veins in primitive rocks in Saxony and in Norway.

Genus II.—ZINC-ORE.

Prismatic. Hardness =4.0, 4.5. Sp. gr. =6.2, —6.3.

1. *Prismatic Zinc-Ore.*—Jameson.

Specific Character.—Prismatic. Pyramid unknown. Cleavage P+∞=125° (nearly). Traces of $\breve{P}r$+∞. (Fig. 30, 29.) Streak orange-yellow.

Description.—Colour red. Occurs massive, and disseminated. Internally shining. Fracture conchoidal. Translucent on the edges, or opaque.

Geognostic and Geographic Situations.—Occurs imbedded in primitive limestone and magnetic iron-ore in Sussex county, and New Jersey, in North America.

Genus III.—RED COPPER-ORE.

Tessular. Hardness =3.5, —4.0. Sp. gr. =5.6, —6.0.

1. *Octahedral Red Copper-Ore.*—Jameson.

Octaedrisches Kupfererz, *Mohs.*—Roth Kupfererz, *Werner.*—Cuivre oxydulé, *Haüy.*

Specific Character.—Tessular. Cleavage octahedral. Streak red.

Description.—Colours red. Occurs regularly crystallized, and in granular distinct concretions; massive, disseminated, and in flakes. Lustre ranges from shining to glimmering, and is adamantine, inclining to semi-metallic. Fracture uneven. Ranges from translucent to opaque.

The varieties with cleavage are named *foliated red copper-ore;* those which are massive, glistening, and opaque, *compact red copper-ore;* and the varieties in capillary crystals, *capillary red copper-ore.*

Geognostic and Geographic Situations.—Occurs in veins in gneiss, mica-slate, clay-slate, and grey-wacke; and in veins and beds in secondary rocks. The copper mines of Cornwall afford fine examples of this beautiful ore.

Genus IV.—TIN-ORE.

Zinnerz, *Mohs.*

Pyramidal. Streak not black. Hardness =6.0, —7.0. Sp. gr. =6.3, —7.0.

1. *Pyramidal Tin-Ore.*—Jameson.

Pyramidales Zinnerz, *Mohs.*

Specific Character.—Pyramidal. Pyramid =133° 25′; 67° 59′. Cleavage P+∞. [P+∞]. Streak white, grey, and brown.

Description.—Colours brown, black, green, white, yellow, and red. Occurs regularly crystallized; also reniform, botryoidal, and globular, and in delicate fibrous concretions. Externally splendent; internally ranges from splendent to glimmering, and is adamantine, inclining to resinous. Fracture uneven. Ranges from semi-transparent to opaque.

The varieties in fibrous concretions are named *wood-tin*, the others *common tinstone.*

Geognostic and Geographic Situations.—Occurs in granite, gneiss, mica-slate, clay-slate, porphyry, and in alluvial depositions. The mines of Cornwall afford all its varieties.

Genus V.—Wolfram-Ore.

Scheel-erz, *Mohs*.

Prismatic. Hardness =5.0, —5.5. Sp. gr. =7.1, —7.4.

1. *Prismatic Wolfram.*—Jameson.

Prismatisches Scheel-erz, *Mohs.*—Wolfram, *Werner.*—Scheelin ferrugineé, *Haüy*.

Specific Character.—Prismatic. Pyramid =115° 23′; 98° 12′; 115° 23′. P+∞=98° 12′. Combination hemi-prismatic, $\frac{P}{2}$=115° 23′. Cleavage, $\breve{P}r+\infty$, perfect. (Fig. 29.) Streak dark reddish-brown.

Description.—Colour brownish-black. Occurs regularly crystallized, and massive. Lustre ranges from splendent to glistening, and is adamantine, inclining to resinous. Fracture uneven. Opaque.

Geognostic and Geographic Situations.—Occurs in primitive rocks in the Island of Rona, one of the Hebrides, and in Cornwall.

Genus VI.—Tantalum-Ore.

Tantal-erz, *Mohs*.

Prismatic. Streak brownish-black. Hardness = 6.0. Sp. gr. =6.0, —6.3.

1. *Prismatic Tantalum-Ore.*—Jameson.

Prismatisches Tantal-erz, *Mohs*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage unknown.

Description.—Colour black. Occurs regularly crystallized; massive and disseminated. Lustre shining and glistening, and semi-metallic-adamantine. Fracture uneven, or conchoidal. Opaque.

Geognostic and Geographic Situations.—Occurs in granite in Finland; in granite, along with beryl, iolite, uran-mica, and iron pyrites, at Bodenmais, in Bavaria.

Genus VII.—Uranium-Ore.

Uran-erz, *Mohs*.

Form unknown. Streak black. Hardness =5.5. Sp. gr. 6.4, —6.6.

1. *Uncleavable Uranium-Ore.*—Jameson.

Untheilbares Uran-erz, *Mohs.*—Uran-pecherz, *Werner.*—Uran oxydulé, *Hauy*.

Specific Character.—Uncleavable, reniform, and massive. No cleavage.

Description.—Colour black. Occurs in granular, lamellar, and prismatic concretions; also massive, and reniform. Lustre shining, and adamantine, inclining to semi-metallic. Fracture conchoidal, passing into uneven. Opaque.

Geognostic and Geographic Situations.—Occurs in veins in primitive rocks, along with native silver, red silver, iron and copper pyrites, galena, blende, and brown-spar. The only British locality is Cornwall.

Genus VIII.—Cerium-Ore.

Cerer-erz, *Mohs*.

Form unknown. Streak white. Hardness =5.5. Sp. gr. =4.6, —5.0.

1. *Uncleavable Cerium-Ore.*—Jameson.

Untheilbares Cerer-erz, *Mohs.*—Cerer-erz, *Werner.*—Cerium oxydé silicifère, *Hauy*.

Specific Character.—Massive. No cleavage.

Description.—Colours red and brown. Occurs massive and disseminated. Internally glimmering, and adamantine. Fracture splintery. Opaque.

Geognostic and Geographic Situations.—Occurs in a bed of copper pyrites in gneiss, near Ridderhyttan, in Westmannland, in Sweden.

* *Allanite, or Prismatic Cerium Ore.*

Colour brownish-black. Prismatic. P+∞ =117° (nearly.) Streak greenish-grey. Sp. gr. =3.5, —4.0. Found in West Greenland.

** *Cerin.*

Colour brownish-black. Prismatic. Cleavage prismatoidal. Streak yellowish grey...brown. Hardness =5.5, —6.0. Sp. gr. =4.1, —4.3. Found in Sweden.

Genus IX.—Chrome-Ore.

Chrom-erz, *Mohs*.

Prismatic. Streak brown. Hardness =5.5. Sp. gr. =4.4, —4.5.

1. *Prismatic Chrome-Ore, or Chromat of Iron.*—Jameson.

Prismatisches Chrom-erz, *Mohs.*—Chrom-eisenstein, *Werner.*—Fer chromaté, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatoidal.

Description.—Colour intermediate between steel-grey and iron-black, and sometimes passes into brownish-black. Occurs regularly crystallized; also in granular distinct concretions; massive and disseminated. Internally shining and glistening, and imperfect metallic. Fracture uneven. Opaque.

Geognostic and Geographic Situations.—Occurs in imbedded masses, and in veins in serpentine, porphyry, and secondary trap. In Scotland it occurs principally in serpentine rocks, and more abundantly in the Shetland Islands than in any other quarter.

Genus X.—Iron-Ore.

Eisen-erz, *Mohs*.

Tessular, rhomboidal, prismatic. Hardness = 5.0, —6.5. Sp. gr. =3.8, —5.2. If the streak is brown, the sp. gr. is below 4.2, or above 4.8. If the streak is black, the sp. gr. is above 4.8.

1. *Octahedral Iron-Ore.*—Jameson.

Octaedrisches eisenerz, *Mohs.*—Fer oxydulé, *Hauy.*—Magnet-eisenstein, *Werner*.

Specific Character.—Tessular. Cleavage octahedral. Streak black. Hardness =5.5, —6.5. Sp. gr. 4.8, —5.2.

Description.—Colour iron-black. Occurs regularly crystallized; in granular distinct concretions, and in loose grains; massive and disseminated. Lustre ranges from splendent to glistening, and is metallic. Fracture uneven, or conchoidal. Opaque.

The variety in grains is named *iron-sand*. The other varieties, *common magnetic iron ore*.

Geognostic and Geographic Situations.—Occurs in

beds, often of vast thickness and great extent, in rocks of the older formations, as gneiss, mica-slate, hornblende-slate, clay-slate, and primitive greenstone, variously disposed in granite, syenite, serpentine, and chlorite-slate; less frequently in transition rocks, in veins, beds, and imbedded masses, as in transition porphyry; and still less frequently in secondary trap-rocks. The serpentine, chlorite, and gneiss rocks of the Shetland Islands afford examples of this ore; the same is the case on the Mainland of Scotland, both in primitive and secondary rocks.

2. *Rhomboidal Iron-Ore.*—Jameson.

Rhomboedrisches Eisen-erz, *Mohs.*—Fer oligiste, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid = 85° 58′. Cleavage R. Sometimes R—∞. Streak red,...,reddish-brown. Hardness =5.5, —6.5. Sp. gr. =4.8, —5.2.

Description.—Colours dark steel-grey bordering on iron-black, iron-black and brownish-red. Occurs regularly crystallized; in granular, lamellar, and fibrous distinct concretions; massive, disseminated, reniform, botryoidal, stalactitic, and globular. Lustre ranges from splendent to dull, and is metallic and semi-metallic. Fracture conchoidal or earthy. Ranges from translucent to opaque.

The dark steel-grey and iron-black varieties, which are generally more or less regularly crystallized, are named *specular iron-ore*, or *iron-glance;* the red varieties are named *red iron-ore.*

Geognostic and Geographic Situations.—The specular iron-ore occurs in gneiss, granite, mica-slate, transition clay-slate, greywacke, and less frequently in secondary rocks. The Island of Elba affords the richest and most beautiful varieties of specular iron-ore, and specimens of considerable beauty are met with in Fitful-head in Shetland, and near Dunkeld in Perthshire. The red iron-ore occurs also in primitive rocks, but less frequently than in those of the transition class, as greywacke and transition clay-slate; and considerable depositions of it are met with in secondary sandstone districts. Ulverstone in Lancashire and other parts of England afford beds and veins of this ore.

3. *Prismatic Iron-Ore.*—Jameson.

Prismatisches Eisen-erz, *Mohs.*—Braun Eisenstein, *Werner.*—Fer oxydé, *Hauy.*—Fer Hydraté, *Daubuisson.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatic. Streak yellowish-brown. Hardness =5.0, —5.5. Sp. gr. =3.8, —4.2.

Description.—Colours brown and yellow. Occurs regularly crystallized; in granular, fibrous, and lamellar distinct concretions; massive, stalactitic, coralloidal, reniform, botryoidal, tuberose, cylindrical, and fruticose. Lustre glimmering and semi-metallic, inclining more or less to adamantine. Fracture uneven, even, conchoidal, or earthy. Translucent on the edges, or opaque.

Geognostic and Geographic Situations.—Occurs in veins, beds, lenticular masses, and mountain masses, in primitive, transition, and secondary rocks in Great Britain, Germany, and other countries.

* *Bog Iron-Ore.*—Jameson.

Raseneisenstein, *Werner.*

Description.—Colour brown. Occurs massive, vesicular, corroded, amorphous, and tuberose. Some varieties are friable. Lustre ranges from glistening to dull, and is semi-metallic-resinous. Fracture earthy or conchoidal. Opaque. Yields a yellowish-grey streak. Brittle, and easily frangible. Sp. gr. =2.944.

Geognostic and Geographic Situations.—It occurs in alluvial soil and in peat-mosses in various places of Scotland, and in the Orkney, Shetland, and Western Islands.

** *Lievrite. Ienite. Ilvaite.*

Fer Siliceo-calcaire, *Hauy.*

Specific Character.—Prismatic. Pyramid =139° 57′; 117° 38′; 77° 16′. Cleavage $\bar{Pr}$ =113° 2′. P+∞ =112° 37′. $\breve{Pr}$+∞. None distinct. Colour black. Streak black, inclining sometimes to green or brown. Hardness =5.5, —6.0. Sp. gr. =3.825, —4.061.

Description.—Colour black, blackish green. Occurs regularly crystallized; also in distinct concretions, which are scopiform radiated, or straight radiated. Lustre glistening and semi-metallic. Fracture uneven. Opaque.

Geognostic and Geographic Situations.—Occurs associated with epidote, garnet, magnetic iron ore, and arsenic pyrites, in limestone, in the Island of Elba; and has been found in Norway and West Greenland.

Genus XI.—Manganese-Ore.

Mangan-erz, *Mohs.*

Prismatic. Hardness =2.5, —6.0. Sp. gr. =4.3, -4.8.

1. *Prismatic Manganese-Ore, or Black Manganese-Ore.*—Jameson.

Prismatisches Mangan-erz, *Mohs.* — Schwarzer Braunstein and Schwarz-eisenstein, *Werner.*—Manganese oxydé, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage unknown, imperfect. Streak black, inclining to brown. Hardness =5.0, —6.0.

Description.—Colours black and steel-grey. Occurs regularly crystallized; also in fibrous and lamellar distinct concretions; massive, tuberose, fruticose, reniform, and botryoidal. Lustre glimmering, glistening, and imperfect metallic. Fracture conchoidal and uneven. Opaque.

Geognostic and Geographic Situations.—Occurs in veins in primitive, transition, and secondary rocks in Hanover, Saxony, &c.

* *Scaly Brown Manganese-Ore.*—Jameson.

Brauner Eisenrahm, *Werner.*

Description.—Colour between steel-grey and clove-brown. Occurs in crusts, massive, spumous, fruticose, and irregular dendritic. Friable, or friable passing into soft. Composed of scaly particles, which are glistening and metallic. Soils. Feels greasy. Occurs in the mines of Sandlodge, in Shetland.

2. *Prismatoidal Manganese-Ore, or Grey Manganese-Ore.*—Jameson.

Prismatoidisches mangan-erz, *Mohs.*—Graubraunsteinerz, *Werner.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P + ∞. = 100° (nearly). More distinct, $\overset{\circ}{Pr}$ + ∞. (Fig. 30, 29.) Streak black. Hardness = 2.5,—3.0.

Description.—Colour dark steel-grey, inclining to iron-black. Occurs regularly crystallized; in granular, fibrous, and radiated distinct concretions. Lustre shining, glimmering, and metallic. Fracture conchoidal and earthy.

Geognostic and Geographic Situations.—Occurs in veins and imbedded masses in primitive, transition, and secondary rocks. In Aberdeenshire, it occurs in primitive rocks; in Devonshire, in the vicinity of those of the transition class; and in Cornwall, it is associated with clay-slate.

* *Earthy Grey and Brown Manganese-Ore, or Wad.*—Jameson.

Colours grey and brown. Occurs massive, botryoidal, and sometimes pulverulent. Internally dull, but the grey varieties are glimmering. Yields to the nail. It occurs along with the grey manganese-ore in Devonshire and Cornwall.

** *Phosphat of Manganese.*

Pitchy Iron-ore, *Werner.*—Manganese Phosphaté, *Hauy.*

Colour between pitch-black and clove-brown. Occurs massive, and crystallized in oblique prisms. Cleavage, three perpendicular faces, of which one is less perfect than the others. Lustre glistening and resinous. Fracture conchoidal, inclining to even and uneven. Translucent on the edges. Streak yellowish-grey, and brown. Hardness = 5.0,—5.5. Sp. gr. = 3.430, *Vauquelin.* 3.775, *Ullman.* Occurs in disseminated masses in granite near Limoges, in France.

Order IX.—Native Metal.

Lustre metallic. Not black. Hardness = 0...5. Sp. gr. = 5.7,—20. If grey, it is malleable, and the sp. gr. = 7.4, and more. If the hardness = 4.0, it is malleable.

Genus I.—Arsenic.

Form unknown. Tin-white, inclining to lead-grey. Hardness = 3.5. Sp. gr. = 5.7,—5.8.

1. *Native Arsenic.*—Jameson.

Gediegen Arsenik, *Werner* and *Mohs.*—Arsenic natif, *Hauy.*

Specific Character. — Regular form unknown. Cleavage unknown.

Description.—Colour tin-white, which soon tarnishes black on exposure. Occurs massive, in plates, reniform, botryoidal, reticulated, and with impressions. Lustre glistening, glimmering, and metallic. Fracture uneven. Emits, when struck, a ringing sound, and an arsenical odour.

Geognostic and Geographic Situations.—It occurs in metalliferous veins, particularly where they cross each other, in gneiss, mica-slate, clay-slate, and porphyry; seldomer in transition and secondary rocks; rarely in beds, and never in large quantity. The mines of Germany, Norway, Franco, and Russia, afford examples of this mineral.

Genus II.—Tellurium.

Form unknown. Tin-white. Hardness = 2.0,—2.5. Sp. gr. = 6.1,—6.2.

1. *Native Tellurium.*—Jameson.

Gediegenes Tellur, *Mohs.*—Gediegen Sylvan, *Werner.*—Tellur natif, *Hauy.*

Specific Character. — Regular form unknown. Cleavage unknown.

Description.—Colour tin-white. Occurs in granular distinct concretions, massive, and disseminated. Lustre shining and metallic. Rather brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in greywacke, in Transylvania, and also in Tellemark, in Norway.

Genus III.—Antimony.

Tessular, prismatic. Not ductile. White. Hardness = 3.0,—3.5. Sp. gr. = 6.5,—10.0.

1. *Dodecahedral Antimony, or Native Antimony.*—Jameson.

Dodecaedrisches Antimon, *Mohs.*—Gediegen Spiesglas, *Werner.*—Antimoine natif, *Haüy.*

Specific Character.—Tessular. Cleavage octahedral. Dodecahedral.

Description.—Colour tin-white. Occurs regularly crystallized; in granular and lamellar concretions; massive, disseminated, and reniform. Lustre splendent and metallic.

Geognostic and Geographic Situations.—Occurs in metalliferous veins in primitive rocks in Sweden, and in the mountains of Hanover, Dauphiny, Hungary, and Brazil.

2. *Prismatic Antimony, or Antimonial Silver.*—Jameson.

Prismatisches Antimon, *Mohs.*—Spiesglas Silber, *Werner.*—Argent Antimonial, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, P — ∞. $\overset{\circ}{Pr}$. Less distinct, P + ∞. (Fig. 27, 34, 30.) Hardness = 3.5. Sp. gr. = 8.9,—10.0.

Description.—Colour between silver and tin-white. Occurs regularly crystallized, and massive. Lustre splendent and metallic. Sectile.

Geognostic and Geographic Situations.—Occurs in veins in primitive and transition rocks in Furstenberg, Salzburg, Hartz, and Spain.

Genus IV.—Bismuth.

Tessular. Silver-white, inclining to red. Hardness = 2.0,—2.5. Sp. gr. = 8.5,—9 0.

1. *Octahedral Bismuth.*—Jameson.

Octaedrisches Wismuth, *Mohs.*—Gediegen Wismuth, *Werner.*—Bismuth natif, *Hauy.*

Specific Character.—Tessular. Cleavage, octahedral.

Description.—Colour silver-white. Occurs regularly crystallized; massive, disseminated, dentiform, and in leaves with a plumose streaked surface. Lustre splendent and metallic. Malleable.

Geognostic and Geographic Situations.—Occurs in veins in primitive rocks, as gneiss, granite, mica-slate, and clay-slate, in Cornwall, Germany, France, Norway, &c.

Genus V.—Mercury.

Tessular, liquid. Not malleable. White. Hardness =0.0, —3.0. Sp. gr. =10.5, —15.0.

1. *Liquid Native Mercury.*—Jameson.

Flüssiges Mercur, *Mohs.*—Gediegen Quecksilber, *Werner.*—Mercur Natif, *Hauy.*

Specific Character.—Liquid. Tin-white. Hardness =0. Sp. gr. =12.0, —15.0.

Description.—Colour tin-white. Liquid. Splendent and metallic. Opaque.

Geognostic and Geographic Situations.—Rarely in primitive and transition rocks. More frequently in rocks of the coal formation. Deux-Ponts, Idria, and other European mining districts, afford examples of this metal.

2. *Dodecahedral Mercury, or Native Amalgam.*—Jameson.

Dodecaedrisches Mercur, *Mohs.*—Natürlich Amalgam, *Werner.*—Mercur Argental, *Haüy.*

Specific Character.—Tessular. No cleavage. Silver-white. Hardness =1.0, —3.0. Sp. gr. =10.5, —12.5.

Description.—Colour silver-white. Occurs regularly crystallized. Lustre shining and metallic. Fracture uneven. When pressed between the fingers, or cut with a knife, it emits a creaking sound, like artificial amalgam.

Geognostic and Geographic Situations.—Occurs in Deux-Ponts, and other mercury mines, along with cinnabar

Genus VI.—Silver.

Tessular. Ductile. Silver-white. Hardness = 2.5, —3.0. Sp. gr. 10.0, —10.5.

1. *Hexahedral Silver.*—Jameson.

Hexaedrisches Silber, *Mohs.*—Argent Natif, *Hauy.*

Specific Character.—Tessular. No cleavage.

Description.—Colour silver-white, and silver-white inclining to brass-yellow. Occurs regularly crystallized, massive, disseminated, dentiform, filiform, reticulated, and in leaves. Lustre metallic, and ranges from splendent to glimmering. Fracture hackly, Opaque.

The yellow varieties are named *auriferous native silver*, from their containing a portion of gold; the other varieties *common native silver*.

Geognostic and Geographic Situations.—Common native silver occurs in veins, generally occupying their middle or upper parts; and those veins traverse granite, gneiss, mica-slate, clay-slate, hornblende-slate, syenite, and porphyry in primitive mountains, and greywacke in transition mountains. It rarely occurs in secondary rocks, as in sandstone. The mines of Cornwall, Saxony, Hungary, Mexico, afford this mineral in all its forms. The auriferous native silver was formerly found in the mines of Konigsberg in Norway; and, at present, in those of Schlangenberg in Siberia.

Genus VII.—Gold.

Tessular. Yellow. Hardness =2.0, —2.5. Sp. gr. =12.0, —20.0.

1. *Hexahedral Gold.*—Jameson.

Hexaedrisches Gediegen Gold, *Mohs.*—Gediegen Gold, *Werner.*—Or Natif, *Hauy.*

Specific Character.—Tessular. No cleavage.

Description.—Colours gold-yellow and brass-yellow. Occurs regularly crystallized, massive, disseminated, in flakes, in leaves, reticulated, capillary, dentiform, and in grains. Lustre shining, glistening, and metallic. Fracture hackly. Opaque.

The gold-yellow varieties are named *gold-yellow gold*; the brass-yellow varieties, *brass-yellow gold*; those varieties, in which the brass-yellow verges on steel-grey, are named *greyish-yellow gold*; and, lastly, the pale brass-yellow, inclining to silver-white, varieties are named *electrum*, or *argentiferous gold*.

Geognostic and Geographic Situations.—Occurs in veins, and disseminated in granite, syenite, gneiss, mica-slate, hornblende-slate, porphyry, greywacke, clay-slate, &c.; also in various alluvial deposites. The mines of Germany, Hungary, and America, afford examples of the various mineralogical and geological relations of this important mineral.

Genus VIII.—Platina.

Form unknown. Steel-grey. Hardness =4.0, —4.5. Sp. gr. =16.0, —20.0.

1. *Native Platina.*—Jameson.

Gediegen Platin, *Werner, Mohs.*—Platin Natif, *Hauy.*

Specific Character.—Form unknown. No Cleavage.

Description.—Colour pale steel-grey, approaching to silver-white. Occurs in flat grains and rolled pieces. Lustre shining and metallic.

Geognostic and Geographic Situations.—Occurs in alluvial soil, along with grains and loose crystals of chrome-ore, magnetic iron-ore, iron and copper pyrites, osmium, iridium, zircon, spinel, quartz, and native gold, in New Grenada, and Brazil in South America.

* *Osmium-Iridium.*—Colour steel-grey, slightly inclining to silver-white. Occurs in six-sided prisms, and in grains. Lustre shining and metallic. Harder than platina. Not malleable. Sp. gr. =19.5.

Geognostic and Geographic Situations.—Occurs in the same districts in South America, and in the same alluvial formation as affords the platina.

** *Native Palladium.*—Colour steel-grey, inclining to silver-white. Occurs in loose grains. Lustre shining and metallic. Sp. gr. =11.8, —12.14.

Geognostic and Geographic Situations.—Occurs along with platina in alluvial districts in Brazil.

Genus IX.—Iron.

Tessular. Pale steel-grey. Hardness 4.5. Sp. gr. =7.4, —7.8.

1. *Octahedral Iron.*—Jameson.

Octaedrisches Eisen, *Mohs.*—Gediegen Eisen, *Werner.*—Fer Natif, *Haüy.*

Specific Character.—Tessular. No cleavage.

Description.—Colour pale steel-grey. Occurs ramose, and disseminated in meteoric stones. Lustre glimmering, glistening, and metallic. Fracture hackly.

Geographic Situation.—It is a meteoric production, and has been observed to fall from fireballs in Europe, Asia, and America.

N.B.—Native iron is mentioned as having been met with imbedded in graphite in the State of New York in America, and in metallic sulphurets in South America; and *native steel* is enumerated amongst the pseudo-volcanic productions of the department of Allier in France.

Genus X.—Copper.

Tessular. Copper-red. Hardness =2.5, —3.0. Sp. gr. =8.4, —8.9.

1. *Octahedral Copper.*—Jameson.

Octaedrisches Kupfer, *Mohs.*—Gediegen Kupfer, *Werner.*

Specific Character.—Tessular. No cleavage.

Description.—Colour copper-red. Occurs regularly crystallized; massive, dendritic, capillary, botryoidal, and ramose. Lustre glistening and metallic. Fracture hackly.

Geognostic and Geographic Situations.—Occurs in granite, gneiss, mica-slate, clay-slate, primitive limestone, syenite, serpentine, greywacke, secondary limestone, sandstone, and generally in small veins; also in grains, and sometimes in blocks many pounds weight, in alluvial districts. It occurs in serpentine in Shetland, and in the copper mines of Cornwall. Large masses are met with in alluvial districts in the northern parts of North America.

Order X.—Pyrites.

Metallic lustre. Hardness =3.5, —6.5. Sp. gr. =4.1, —7.7 If hardness =4.5, and less, the specific gravity is less than 5.0. If sp. gr. =5.3, and less, the colour is yellow or red.

Genus I.—Nickel Pyrites, or Copper-Nickel.

Prismatic. Hardness =5.0, —5.5. Sp. gr. = 7.5, —7.7.

1. *Prismatic Nickel Pyrites.*—Jameson.

Prismatischer Nickel-kies, *Mohs.*—Kupfer-Nickel, *Werner.*—Nickel Arsenical, *Haüy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage unknown. Copper-red.

Description.—Colour copper-red. Rarely crystallized; in granular distinct concretions; massive, disseminated, reticulated, dendritic, fruticose, globular, and botryoïdal. Lustre shining and metallic. Fracture conchoidal. Brittle.

Geognostic and Geographic Situations.—Occurs in silver and cobalt veins in gneiss, mica-slate, clay-slate, and syenite; also in veins in secondary rocks, particularly bituminous marl-slate. In Scotland it is met with at Leadhills and Wanlockhead, and in the coal-field of West Lothian.

* *Nickel Ochre.*—Colour apple-green. Occurs as a thin coating, seldom massive, and disseminated. Dull. Fracture uneven or earthy. Opaque, or translucent on the edges. Soft. Feels meagre. It occurs in mineral veins along with copper-nickel at Alva in Stirlingshire, in Linlithgowshire, and at Leadhills.

** *Black Nickel.*—Colour black. Occurs massive, disseminated, in crusts. Dull. Fracture earthy. Opaque. Soft. Shining in streak. Soils slightly. It occurs in veins in bituminous marl-slate at Riegelsdorf in Hessia.

Genus II.—Arsenic Pyrites.

Prismatic. Hardness =5.0, —6.0. Sp. gr. =5.7, —7.4. If white, the sp. gr. =6.2, and less. If grey, the sp. gr. above 6.8.

1. *Axotomous Arsenic Pyrites.*—Jameson.

Axentheilender Arsenik-kies, *Mohs.*—Arsenk-kies, *Werner.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage P—∞. Less distinct P+∞. (Fig 27, 30.) Pale steel-grey. Hardness =5.0, —5.5. Sp. gr. = 6 9, —7.4.

Description. — Colour pale steel-grey. Occurs massive. Lustre metallic and shining.

Its locality unknown.

2. *Prismatic Arsenic Pyrites.*—Jameson.

Prismatischer Arsenik-kies, *Mohs.*—Arsenik-kies, *Werner.*—Fer Arsenical, *Hauy.*

Specific Character.—Prismatic. Pyramid =154° 48′; 100° 34′; 84° 56′. P+∞, 147° 3′. Cleavage P—∞. $(\breve{P}r+\infty)^3$ =111° 19′. (Fig. 27, 32.) White, inclining to steel-grey. Hardness =5.5,—6.0. Sp. gr. =5.7, —6.2.

Description.—Colour silver-white. Occurs regularly crystallized; in prismatic concretions, massive and disseminated. Lustre ranges from splendent to glistening, and is metallic. Fracture uneven. Opaque. Brittle.

Geognostic and Geographic Situations.—This mineral occurs in a variety of metalliferous formations in primitive mountains, and also in those of the transition and secondary classes. In Scotland it occurs in secondary rocks in Stirlingshire, and in considerable quantity in the mines of Devon and Cornwall.

Genus III.—Cobalt Pyrites.

Tessular. Hardness =5.5. Sp. gr. =6.0,—6.6.

1. *Hexahedral Cobalt-Pyrites, or Silver-White Cobalt.*—Jameson.

Hexaedrischer Kobalt-kies, *Mohs.*—Glanz Kobold, *Werner.*—Cobalt gris, *Hauy.*

Specific Character.—Tessular. Combination semitessular of parallel planes. Cleavage, hexahedral and perfect. White, inclining to red. Hardness =5.5. Sp. gr. =6.1,—6.3.

Description.—Colour silver-white, inclining to copper-red. Occurs regularly crystallized; in granular distinct concretions, massive, disseminated.

and reticulated. Lustre shining, glistening, and metallic. Fracture conchoidal. Brittle. Easily frangible.

Geognostic and Geographic Situations.—Occurs in beds, in mica slate, associated with iron and copper-pyrites, magnetic iron-ore, anthophyllite, tourmaline, felspar, &c. in parish of Modum, in Norway, also at Tunaberg, in Sweden. In some transition districts it is found in veins along with various ores of iron and copper.

2. *Octahedral Cobalt-Pyrites, or Tin-White Cobalt.*—Jameson.

Octaedrischer Cobalt-kies, *Mohs.*—Weisser Speiskobald, *Werner.*—Cobalt Arsenical, *Hauy.*

Specific Character.—Tessular. Cleavage hexahedral, octahedral, dodecahedral, but very indistinct; sometimes the hexahedral is more distinct. Tin-white, inclining to steel-grey. Hardness =5.5. Sp. gr. =6.0,—6.6.

Description.—Colour tin-white, inclining to steel-grey. Occurs regularly crystallized; in lamellar and granular concretions; massive, disseminated, reticulated, fruticose, specular. Lustre shining, splendent, and metallic. Fracture uneven. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in veins in primitive and transition rocks; also in old red sandstone, and in copper-slate. Cornwall, Hessia, Thuringia, Hartz, &c. afford many localities of this mineral.

* *Grey Cobalt Pyrites.*—Jameson.

Grauer Speisskobalt, *Werner.*—Cobalt Arsenical Amorphe, *Hauy.*

On the fresh fracture is steel-grey, but on exposure becomes greyish-black. Occurs massive, tubiform, and specular. Lustre glimmering, glistening, and metallic, but the specular variety is splendent. Fracture uneven, conchoidal, or even. Brittle. Shining in streak. Same hardness as hexahedral cobalt-pyrites. Brittle. Sp. gr. =7.0. Occurs in veins in primitive rocks in Cornwall.

** *Cobalt-Kies.*—Haussmann.

Colour pale steel-grey, which on exposure becomes nearly copper-red. Occurs massive, disseminated, and in cubes. Lustre shining and metallic. Fracture uneven or conchoidal. Semihard. Occurs in a bed of copper pyrites in gneiss, at Riddarhytan, in Sweden.

*** *Radiated Tin-white Cobalt Pyrites.*—Jameson.

Strahliger Weisser Speisskobald, *Werner.*

Colour tin-white, passing into steel-grey. Occurs massive, disseminated, and reniform; also in scopiform and stellular radiated, and fibrous concretions. Lustre glistening and metallic. Fracture uneven. Softer than octahedral cobalt pyrites. Occurs in Saxony and Norway, but is a rare mineral.

Genus IV.—Iron Pyrites.

Tessular, rhomboidal, prismatic. Yellow. Hardness =3.5, —6.5. Sp. gr. =4.4, —5.0.

1. *Hexahedral Iron-Pyrites.*—Jameson.

Hexaedrischer Eisen-Kies, *Mohs.*—Gemeiner Schwefel-Kies, *Werner.*—Fer Sulphure, *Hauy.*

Specific Character.—Tessular. Combination, semi-tessular of parallel planes. Bronze-yellow. Hardness =6.0, —6.5. Sp. gr. =4.7, —5.0.

Description.—Colour bronze-yellow, sometimes inclining to steel-grey. Occurs regularly crystallized; in granular concretions, massive, disseminated, globular, and cellular. Lustre ranges from shining to glimmering, and is metallic. Fracture uneven and conchoidal. Opaque. Brittle.

Geognostic and Geographic Situations.—The *cellular varieties* are rare, and hitherto have been met with principally in Saxony; while the others occur in all countries, and more or less extensively distributed through rocks of every description, from those of the oldest primitive, to the newest alluvial formations.

2. *Prismatic Iron Pyrites.*—Jameson.

Prismatischer Eisenkies, *Mohs.*—Fer Sulphure Blanc, *Hauy.*

Specific Character.—Prismatic. Pyramid =115° 53′; 89° 11′; 125° 16′. Cleavage, P+∞ =106° 36′. (Fig. 30.) Colour bronze-yellow. Hardness =6.0, —6.5. Sp. gr. =4.7, —5.0.

Description.—Colour bronze-yellow, inclining sometimes to steel-grey, or to brass-yellow. Occurs regularly crystallized; in radiated, granular, and lamellar concretions; massive, dendritic, reniform, globular, stalactitic, botryoidal, fruticose, and with impressions. Lustre varies from glistening to glimmering, and is metallic. Opaque. Brittle. Easily frangible.

The varieties in radiated concretions are named *radiated pyrites;* those in which the colour inclines to brass-yellow, and which, on exposure to air, acquire a brown tarnish, are named *hepatic pyrites;* those in spear-shaped twin and triple crystals, *spear-pyrites;* and lastly, those in which the crystals are so aggregated as to have the form of the comb of the cock, are named *cockscomb-pyrites.*

Geognostic and Geographic Situations.—This species of iron-pyrites occurs more frequently and abundantly in newer than in older formations. The newest secondary formations, and those of the alluvial class, both in this island and on the continent of Europe, afford numerous localities of the radiated varieties. The spear-pyrites is met with in Bohemia and Saxony; and the cockscomb-pyrites in veins in Derbyshire, and in some mines in Saxony.

3. *Rhomboidal Iron-Pyrites.*—Jameson.

Rhomboedrischer Eisenkies, *Mohs.*—Magnetkies, *Werner.*—Fer Sulphuré Ferrifère, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid unknown. Combination di-rhomboidal. Cleavage, R —∞. Less distinct P+∞. Colour bronze-yellow, inclining to copper-red. Hardness =3.5, —4.5. Sp. gr. 4.4,—4.7.

Description.—Colours intermediate between bronze-yellow and copper-red. Occurs rarely crystallized; in granular concretions, also massive and dis-

 seminated. Lustre ranges from splendent to glistening, and is metallic. Fracture conchoidal and uneven. Opaque. Brittle. Easily frangible.

Geognostic and Geographic Situations.—This mineral occurs disseminated in primitive and transition rocks, and also disposed in beds in rocks of the same classes, in Scotland, England, Saxony, &c.

Genus V.—Copper Pyrites.

Pyramidal. Hardness =3.5, —4.0. Sp. gr. = 4.1, —4.3.

1. *Pyramidal Copper-Pyrites, or Yellow Copper-Pyrites.*—Jameson.

Pyramidaler Kupfer-kies, *Mohs.*—Kupfer-kies, *Werner.*—Cuivre pyriteux, *Hauy.*

Specific Character.—Pyramidal. Pyramid 109° 53′; 108° 40′. Combination hemi-pyramidal, of inclined planes. Cleavage, P+1=101° 49′; 126° 11′. Brass-yellow.

Description.—Colour brass-yellow. Occurs regularly crystallized; massive, disseminated, in flakes, dendritic, reniform, botryoidal, stalactitic, and specular. Internally shining, glimmering, and metallic. Fracture uneven and conchoidal. Brittle, and easily frangible.

Geognostic and Geographic Situations.—This species of pyrites is found in all the great classes of rocks, and not only in veins, but also in beds, and in vast imbedded masses. The copper mines in England afford it in great variety and abundance; and it occurs also in Scotland, but in smaller quantities.

Undetermined Pyrites.

1. *Nickeliferous Grey Antimony.*

Antimoine Sulphure Nickelifere, *Hauy.*

Tessular. Cleavage, hexahedral, perfect. Metallic lustre. Colour steel-grey, somewhat inclining to silver-white. Hardness =5.0,—5.5. Sp. gr. =6.4, —6.6. Occurs in veins along with galena, sparry-iron, and copper-pyrites, in the principality of Nassau.

2. *Tin-Pyrites.*

Etain Sulphuré, *Hauy.*

Colour intermediate between steel-grey and brass-yellow. Occurs massive, and disseminated. Internally glistening, shining, and metallic. Fracture uneven, inclining to conchoidal. Brittle, and easily frangible. Hardness =4.0. Sp. gr. =4.350, *Klaproth.* Occurs in copper mines in Cornwall.

Order XI.—Glance.

Lustre metallic. Grey, black. Hardness =1.0. —4.0. Sp. gr. =4.0, —7.6. If sp. gr. under 5.0, and cleavage monotomous, the colour is lead-grey, If sp. gr. above 7. 4, the colour is lead-grey.

Genus I.—Copper-Glance.

Tessular, prismatic. Hardness =2.5, 4.0. Sp. gr. =4. 4, —5.8. If sp. gr. above 5.0, the colour is blackish-lead-grey. If sp. gr. under 5.0, it is steel-grey, or black.

1. *Tetrahedral Copper-Glance.*—Jameson.

Tetraedrischer Kupfer-glanz, *Mohs.*—Fahlerz. Schwarzerz, *Werner.*—Cuivre gris, *Hauy.*

Specific Character.—Tessular. Combination semi-tessular of inclined planes. Cleavage, octahedral. Colour steel-grey,...iron-black. Hardness = 3.0, —4.0. Sp. gr. =4.4, —4.9.

Description.—Colour steel-grey, and iron-black. Occurs regularly crystallized, massive, and disseminated. Lustre externally splendent and metallic, internally shining, or glistening, and metallic. Fracture conchoidal or uneven. Opaque, brittle, and easily frangible.

The grey varieties are named *grey copper*; the black, *black copper.*

Geognostic and Geographic Situations.—The grey varieties occur in veins in transition granite, and syenite, at Fasseney Burn, in East-Lothian; at Airthrie, in Stirlingshire; in Ayrshire, and in Devonshire. The black varieties are found in transition rocks, at Claasthal, in the Hartz.

2. *Prismatoidal Copper-Glance.*—Jameson.

Prismatoidischer Kupfer-glanz, *Mohs.*—Prismatic Antimony Glance, *J.*

Specific Character. — Prismatic. Pyramid unknown. Cleavage, $\breve{P}r+\infty$. (Fig. 29.) Blackish lead-grey. Brittle. Hardness =3.0. Sp. gr. = 5.7, —5.8.

Description.—Colour blackish lead-grey. Crystals in oblique four-sided prisms. Lustre shining and metallic.

3. *Prismatic Copper-Glance, or Vitreous Copper.*—Jameson.

Prismatischer Kupfer-glanz, *Mohs.*—Kupferglas, *Werner.*—Cuivre Sulphuré, *Hauy.*

Specific Character. — Prismatic. Pyramid unknown. Cleavage, P+∞=120° (nearly). $\breve{P}r+\infty$. (Fig. 30, 29.) Sectile in a high degree. Blackish lead-grey. Hardness =2.5, —3.0. Sp. gr. =5.5, —5.8.

Description.—Colour blackish lead-grey. Occurs regularly crystallized, also in granular concretions, and massive. Lustre glistening, glimmering, and metallic. Fracture conchoidal and uneven. Opaque. Sectile, and rather easily frangible.

Geognostic and Geographic Situations.—Occurs in veins at Fassney Burn; in the rocks of Fair Isle; in Yorkshire, Caernarvonshire, and Cornwall.

* *Variegated Copper.*—Jameson.

Buntkupfererz, *Werner.*—Cuivre Pyriteux Hepatique, *Hauy.*

Colour between copper-red and pinchbeck-brown, but soon obtains a variegated tarnish. Occurs in cubes truncated on the angles, and massive. Lustre shining and metallic. Cleavage octahedral. Fracture conchoidal. Sp. gr. =5.03.

Geognostic and Geographic Situations.—Occurs in veins in primitive, transition, and secondary rocks. Found in Cornwall and other mining districts.

** *Argentiferous Copper-Glance.*

Silber Kupfer-glanz, *Hausmann.*

Colour blackish lead-grey. Massive, and disseminated. Internally shining or glistening, and metallic. Fracture flat, conchoidal. Lustre increased in the streak. Soft. Sectile. Rather difficultly frangible. Sp. gr. =6.255, *Stromeyer*. Occurs along with copper-pyrites, calcareous spar, and hornstone, at Schlangenberg, in Siberia.

*** *Plumbiferous Copper-Glance*.

Bleifahlerz, *Hausmann*.

Prismatic. Cleavage, P—∞. Less distinct, P+∞=95° (nearly). $\breve{P}r+\infty$. $\bar{P}r+\infty$. Metallic lustre. Steel-grey, inclining to lead-grey. Hardness =2.5,—3.0. Sp. gr. =5.7,—5.8. Occurs in veins that traverse clay-slate in the Hartz.

**** *Tennantite*.—Phillips.

Tessular. Cleavage, dodecahedral. Colour lead-grey, inclining to iron-black. Streak reddish-grey. Hardness =4.0. Sp. gr. =4.375, *Phillips*. Occurs in veins of copper-ore in Cornwall.

***** *Eukairite, or Seleniferous Copper-Glance*.—Berzelius.

Colour lead-grey. Occurs massive. Lustre shining and metallic. Fracture fine grained, uneven. Opaque. Soft. Can be cut with the knife, and receives an impression from the hammer. Streak shining. Powder of streak-grey. This remarkable copper-glance, which contains twenty-six parts of the new metal named Selenium, occurs in an old copper mine in Smaland, in Sweden.

Genus II.—Silver Glance, or Vitreous Silver.

Silber-glanz, *Mohs*.

Tessular. Blackish lead-grey. Hardness =2.0, —2.5. Sp. gr. =6.9, —7.2.

1. *Hexahedral Silver-Glance*.—Jameson.

Hexaedrischer Silber-glanz, *Mohs*.—Glaserz, *Werner*.—Argent Sulphuré, *Hauy*.

Specific Character.—Tessular. Cleavage not discernible. Malleable.

Description.—Colour blackish lead-grey. Occurs regularly crystallized; massive, disseminated, in plates, dentiform, filiform, capillary, reticulated, dendritic, stalactitic, and with impressions. Lustre shining, glistening, and metallic. Fracture uneven or conchoidal. Completely malleable. Flexible, but not elastic.

Geognostic and Geographic Situations.—It is one of the most common of the ores of silver. It was formerly met with at Airthrie in Stirlingshire, and is still found in the mines of Cornwall.

Genus III.—Galena, or Lead-Glance.

Tessular. Pure lead-grey. Hardness =2.5. Sp. gr. =7.0,—7.6.

1. *Hexahedral Galena, or Lead-Glance*.—Jameson.

Hexaedrischer Bleiglanz, *Mohs*.—Bleiglanz, *Werner*.—Plomb sulphuré, *Hauy*.

Specific Character.—Tessular. Cleavage, hexahedral.

Description.—Colour lead-grey. Occurs regularly crystallized; in granular, prismatic, and lamellar concretions; massive, disseminated, specular, reticulated, botryoidal, and corroded. Lustre splendent to glimmering and metallic. Fracture even, or flat conchoidal. Fragments cubical. Sectile. Uncommonly easily frangible.

The variety with glimmering lustre, and even or conchoidal fracture, is named *compact galena*.

Geognostic and Geographic Situations.—This mineral, which is the species from which all the lead of commerce is obtained, occurs in every lead mine, whether in primitive, transition, or secondary rocks.

* *Blue Lead*.—Jameson.

Blau Bleierz, *Werner*.

Description.—Colour between dark indigo-blue and dark lead-grey. Occurs massive, and in six-sided prisms. Is glimmering and metallic. Fracture uneven, or small conchoidal. Opaque. Streak shining. Sectile, and easily frangible. Is rare, and hitherto has been found principally in lead mines in Saxony and France.

Genus IV.—Tellurium-Glance, or Black Tellurium.

Tellur-Glanz, *Mohs*.

Prismatic. Cleavage, montomous. Hardness = 1.0,—1.5. Sp. gr. =7.0,—7.2.

1. *Prismatic Tellurium-Glance*.—Jameson.

Prismatischer Tellur-glanz, *Mohs*.—Nagyagerz, *Werner*.—Tellure natif auro-plombifère, *Hauy*.

Specific Character.—Prismatic. Pyramid unknown. Cleavage, axotomous, or prismatoidal, and very perfect. Blackish lead-grey. Iron black.

Description.—Colour blackish lead-grey, and iron-black. Occurs regularly crystallized; massive, disseminated, and in leaves. Lustre splendent and metallic. Sectile.

Geognostic and Geographic Situations.—Occurs in veins that traverse porphyry, in Transylvania.

Genus V.—Molybdena, or Molybdena-Glance.

Molybdän-Glanz, *Mohs*.

Rhomboidal. In thin leaves. Easily flexible. Hardness =1.0, —1.5. Sp. gr. =4.4, —4.6.

1. *Rhomboidal Molybdena*.—Jameson.

Rhomboedrischer Molybdän, *Mohs*.—Wasserblei, *Werner*.—Molybdene sulphuré, *Hauy*.

Specific Character.—Rhomboidal. Rhomboid unknown. Combination di-rhomboidal. Cleavage R—∞, perfect. Pure lead-grey.

Description.—Colour fresh lead-grey. Occurs regularly crystallized; massive, disseminated, in plates, and in granular concretions. Lustre splendent or shining and metallic. Sectile, approaching to malleable.

Geognostic and Geographic Situations.—Occurs imbedded in granite and syenite at Peterhead; in chlorite-slate in Glenelg; in granite and syenite in Corybuy, at the head of Loch Creran, and in various mines in Cornwall.

* *Molybdena Ochre.*—Jameson.

The sulphur yellow mineral which sometimes incrusts molybdena is named *molybdena ochre.*

Genus VI.—Bismuth-Glance.

Prismatic. Pure lead-grey. Hardness $=2.0$, -2.5. Sp. gr. $=6.1$, -6.4.

1. *Prismatic Bismuth-Glance.*—Jameson.

Prismatischer Wismuth-Glanz, *Mohs.*—Wismuth-Glanz, *Werner.*—Bismuth sulphuré, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage $P+\infty$. $\overset{o}{P}r+\infty$. $P\bar{r}+\infty$. (Fig. 30, 29, 28.)

Description.—Colour pale lead grey. Occurs regularly crystallized; in granular and radiated concretions; massive and disseminated. Internally splendent and metallic. Soils. Brittle, inclining to sectile. Easily frangible.

Geognostic and Geographic Situations.—Occurs in veins in Cornwall.

* *Bismuth Ochre.*—Jameson.

Wismuth-ocker, *Werner.*

The yellow, grey, or green mineral which sometimes accompanies bismuth-glance, is the bismuth ochre of mineralogists.

Genus VII.—Antimony Glance.

Antimon-Glanz, *Mohs.*

Prismatic. Hardness $=1.5$,—2.5. Sp. gr. $=4.0$, —5.8. If Sp. gr. under 5.0, the hardness $=2.0$, and if sp. gr. above 5.0, the colour is steel-grey.

1. *Prismatic Antimony-Glance.*—Jameson.

Prismatischer Antimon-glanz, *Mohs.*—Schrift-erz, *Werner.*—Tellure natif auro-argentifère, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $\overset{o}{P}r+\infty$, perfect. Less distinct, $P\bar{r}+\infty$. (Fig. 29, 28.) Pure steel-grey. Hardness $=1.5$,—2.0. Sp. gr. $=5.7$,—5.8.

Description.—Colour steel-grey. Occurs regularly crystallized; massive, disseminated, and in leaves. Externally splendent, internally glistening, and metallic. Fracture uneven. Rather brittle.

Geognostic and Geographic Situations.—Occurs in porphyry veins in Transylvania.

2. *Prismatoidal Antimony-Glance, or Grey Antimony.*—Jameson.

Grau Spiesglaserz, *Werner.*—Prismatoidischer Antimon-Glanz, *Mohs.*—Antimoine sulphuré, *Hauy.*

Specific Character.—Prismatic. Pyramid 110° 58′; 107° 56′; 109° 24′. Cleavage, $\overset{o}{P}r+\infty$. perfect. Less distinct, $P-\infty$. $P+\infty=92°\ 10'$. $P\bar{r}+\infty$. (Fig. 29, 27, 30, 28.) Lead-grey. Hardness $=2.0$. Sp. gr. $=4.0$,—4.6.

Description.—Colour lead-grey. Occurs regularly crystallized, in radiated, fibrous, and granular distinct concretions. Lustre ranges from glistening to splendent, and is metallic. Fracture even and uneven. Rather brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in veins that traverse greywacke, at Westerhall, in Dumfries-shire, and in Banffshire in primitive rocks.

3. *Axotomous Antimony-Glance, or Bournonite.*—Jameson.

Axentheilender Antimon-Glanz, *Mohs.*—Triple Sulphuré d'Antimoine, Plomb et Cuivre; Endellione, Bournon.

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P-\infty$, very perfect. (Fig. 27.) Steel-grey. Hardness $=2.0$, —2.5. Sp. gr. $=5.5$, —5.8.

Description.—Colour steel-grey. Occurs regularly crystallized, and massive. Lustre externally shining, internally glistening, and metallic. Fracture uneven or conchoidal. Opaque. Very brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in veins in clay-slate in Cornwall.

Genus VIII.—Melane-Glance.

Prismatic. Black, partly inclining to lead-grey. Hardness $=2.0$, —3.0. Sp. gr. $=5.9$, —6.6.

1. *Diprismatic Melane-Glance, or Black Antimony-Ore.*—Werner, Jameson.

Diprismatischer Melan-Glanz, *Mohs.*—Schwarz Spiesglaserz, *Werner.*—Plomb Sulphuré-Antimonifère, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P\bar{r}+\infty$. $\overset{o}{P}r+\infty$, the latter somewhat more discernible, but both imperfect. (Fig. 28, 29.) Iron-black, inclining to lead-grey. Hardness $=2.5$, —3.0. Sp. gr. $=6.4$, —6.6.

Description.—Colour iron-black, inclining more or less to steel-grey. Occurs regularly crystallized, and massive. Lustre shining, splendent, and metallic. Fracture conchoidal. Rather brittle, and easily frangible.

Geognostic and Geographic Situations.—Occurs in veins in primitive and transition rocks, in Transylvania and Saxony.

2. *Prismatic Melane-Glance, or Brittle Silver-Glance.*—Jameson.

Prismatischer Melan-Glanz, *Mohs.*—Sprödglaserz, *Werner.*—Argent Antimoine-Sulphuré Noire, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, $P+\infty=124°$ (nearly). $\overset{o}{P}r+\infty$, imperfect. (Fig. 30, 29.) Iron-black. Hardness $=2.0$, —2.5. Sp. gr. $=5.9$, —6.4.

Description.—Colour between iron-black and dark lead-grey. Occurs regularly crystallized and disseminated. Lustre externally splendent, internally shining, and metallic. Fracture conchoidal and uneven.

Geognostic and Geographic Situations.—Occurs in veins in primitive rocks in Hungary.

Order XII.—Blende.

Hardness $=1.0$, —4.0. Sp. gr. $=3.9$, —8.2. If the lustre is metallic, the colour is black. If the lustre is not metallic, it is adamantine. If the streak is brown, white, or grey, the sp. gr. is between 4.0,

and 4.2, and the form tessular. If the streak is red, the sp. gr. =4.5, and more; and the hardness =2.5, and less. If the sp. gr. =4.3, and more, the streak is red.

Genus I.—Manganese-Blende.

Glanz-Blende. *Mohs.*—Mangan-Blende, *Werner.*

Prismatic. Streak green. Hardness =3.5, —4.0. Sp. gr. =3.9, —4.0.

1. *Prismatic Manganese-Blende.*—Jameson.

Prismatisches Glanz-Blende, *Mohs.*—Manganese Sulphuré, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatic. Metallic aspect.

Description.—Colour iron-black, which, on exposure, becomes brownish-black. Occurs regularly crystallized, in granular concretions, massive, and disseminated. Lustre splendent, shining, and metallic, inclining to imperfect metallic. Opaque. Streak greenish-grey.

Geognostic and Geographic Situations.—Occurs in Cornwall and in Transylvania in primitive and transition rocks.

Genus II.—Zinc-Blende, or Garnet-Blende.

Granat-Blende, *Mohs.*

Tessular. Streak grey, white, reddish brown. Hardness =3.5, —4.0. Sp. gr. =4.0, —4.2.

1. *Dodecahedral Zinc-Blende.*—Jameson.

Dodecaedrische Granat-Blende, *Mohs.*—Blende, *Werner.*—Zinc Sulphuré, *Hauy.*

Specific Character.—Tessular. Combination, semi-tessular of inclined planes. Cleavage dodecahedral.

Description.—Colours brown, yellow, grey, green, red, and black. Occurs regularly crystallized, also in granular and fibrous distinct concretions, massive, and disseminated. Lustre ranges from specular splendent to glimmering, and is adamantine. Ranges from transparent to opaque. Brittle, and easily frangible.

The varieties in which the yellow colours predominate are named *yellow zinc-blende;* those in which the brown colour predominate *brown zinc-blende;* and, lastly, those in which black is the characteristic colour are named *black zinc-blende.*

Geognostic and Geographic Situations.—Beautiful yellow varieties are met with in the old lead mines of Tyndrum in Perthshire; the brown, or common blende, in every lead mine in England and Scotland; while the black variety, which is the rarest, occurs in small quantity in Saxony, and some other mining countries on the Continent of Europe.

Genus III.—Antimony-Blende, or Red Antimony.

Purpur-Blende, *Mohs.*

Prismatic. Hardness =1.0, —1.5. Sp. gr. = 4.5, —4.6.

1. *Prismatic Antimony-Blende, or Red Antimony.*

Prismatische Purpur-Blende, *Mohs.*—Roth Spiesglas-erz, *Werner.*—Antimoine Oxidé Sulphuré, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage prismatoidal. Streak cherry-red.

Description.—Colour cherry-red, and frequently with a tempered-steel tarnish. Occurs regularly crystallized; in granular, and scopiform and stellular fibrous concretions. Lustre shining and adamantine. Opaque, or translucent on the edges.

Geognostic and Geographic Situations.—Occurs in small quantity in primitive rocks, in Saxony, France, and Hungary.

Genus IV.—Ruby-Blende.

Rubin-Blende, *Mohs.*

Rhomboidal. Hardness =2.0, —2.5. Sp. gr. = 5.2, —8.2.

1. *Rhomboidal Ruby-Blende, or Red Silver.*—Jameson.

Rombocdrische Rubin-Blende, *Mohs.*—Rothgiltigerz, *Werner.*—Argent Antimoinié Sulphuré, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid = 109° 28′. Combination sometimes with different planes on opposite extremities. Cleavage, rhomboidal. Streak cochineal-red. Hardness =2.5. Sp. gr. =5.2, —5.8.

Description.—Colour between cochineal-red and dark lead-grey, and sometimes inclines to carmine-red. Occurs regularly crystallized; massive and disseminated. Lustre ranges from splendent to glimmering, and is adamantine. Fracture uneven or conchoidal. Ranges from opaque to transparent.

Geognostic and Geographic Situations.—In some silver mines it is an abundant ore, and in this country has been hitherto found only in Cornwall.

2. *Peritomous Ruby-Blende, or Cinnabar.*—Jameson

Rubin-Blende, *Mohs.*—Mercure Sulphuré, *Hauy.*

Specific Character.—Rhomboidal. Rhomboid = 71° 48′. Cleavage, $R+\infty$, perfect. Streak scarlet-red. Hardness =2.0, —2.5. Sp. gr. =6.7, —8.2.

Description.—Colours cochineal and scarlet-red, and sometimes inclines to dark steel-grey. Occurs regularly crystallized; in granular and globular concretions; massive, disseminated, and dendritic. Lustre ranges from splendent to glimmering, and is adamantine, verging on semi-metallic. Fracture uneven, conchoidal, and earthy. Ranges from transparent to opaque. Sectile, and easily frangible.

The dark-coloured varieties, inclining to steel-grey, are named *hepatic cinnabar,* the others *common cinnabar.*

Geognostic and Geographic Situations.—Common cinnabar and hepatic cinnabar are the minerals that afford all the mercury of commerce. The first occurs in beds, and imbedded in porphyry rocks and those of the coal formation, while the other appears to be entirely confined to those of the coal formation. The mercury mines of Idria, Almadin, and of Deux-Ponts, afford all the known varieties of this important metalliferous mineral.

Order XIII.—Sulphur.

No metallic lustre. Colour yellow, red or brown. Prismatic. Hardness =1.0, —2.5. Sp. gr. =1.9,

Mineralogy. 3.6. If sp. gr. above 2.1, the streak is yellow or red.

Genus I.—Sulphur.

Prismatic. Hardness =1.5, —2.5. Sp. gr. = 1.9, —3.6.

1. *Prismatoidal Sulphur, or Yellow Orpiment.*— Jameson.

Prismatoidischer Schwefel, *Mohs.*—Gelb-Rausch gelb, *Werner.*—Arsenic Sulphuré, *Hauy.*

Specific Character.—Prismatic. Pyramid unknown. Cleavage, distinctly prismatoidal. Streak lemon-yellow. Hardness =1.5, —2.0. Sp. gr. =3.4, —3.6.

Description.—Colour lemon-yellow. Occurs regularly crystallized; in granular and concentric lamellar concretions; massive, disseminated, stalactitic, reniform, botryoidal, and in crusts. Lustre splendent, between adamantine and semi-metallic. Translucent. Sectile. Flexible, but not elastic.

Geognostic and Geographic Situations.—Occurs in veins in various metalliferous formations in primitive and secondary rocks in Hungary and Germany.

2. *Hemi-prismatic Sulphur, or Red Orpiment.*— Jameson.

Hemiprismatischer Schwefel, *Mohs.*-Roth-Rausch gelb, *Werner.*—Arsenic Sulphuré Rouge, *Hauy.*

Specific Character.—Prismatic. Pyramid =138° 15′; 121° 35′; 74° 21′. Combination hemi-prismatic . $\frac{P}{2}$ =121° 35′. Cleavage, $\frac{\overset{\circ}{Pr}}{2}$. Less distinct, $P+\infty$. =72° 17′. $\bar{Pr}+\infty$. (Inclination of $\frac{\overset{\circ}{Pr}}{2}$ to $\overset{\circ}{Pr}+\infty$ =114° 6′.) (Fig. 36, 30, 28.) Streak orange-yellow . . . . morning-red. Hardness =1.5, —2.0. Sp. gr. =3.3, —3.4.

Description.—Colour aurora-red, inclining sometimes to orange-yellow. Occurs regularly crystallized; massive, disseminated, and in flakes. Lustre shining, and adamantine. Fracture uneven. Translucent and semi-transparent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—Generally occurs in veins in primitive rocks, and sometimes also in those of secondary formations in Germany and other countries.

3. *Prismatic Sulphur, or Common Sulphur.*—Jameson.

Prismatischer Schwefel, *Mohs.*-Naturlicher Schwefel, *Werner.*—Soufre, *Hauy.*

Specific Character.—Prismatic. Pyramid =107° 19′; 84° 24′; 143° 8′. Cleavage, $P.P+\infty$ =102° 41′. (Fig. 30.) Streak white or sulphur-yellow. Hardness =1.5, —2.5. Sp. gr. =1.9, —2.1.

Description.—Colours yellow, brown, and grey. Occurs regularly crystallized; in granular distinct concretions; massive, disseminated, stalactitic, vesicular, and corroded. Lustre ranges from shining to glimmering, and is between adamantine and resinous. Fracture uneven, splintery, or conchoidal. Translucent and transparent. Brittle, and easily frangible. Mineralogy.

Geognostic and Geographic Situations.—This mineral occurs in considerable quantities, along with gypsum, in secondary rocks in Spain and other countries; also in alluvial formations in the vicinity of sulphureous springs, and is very abundantly formed in some active volcanoes in Italy and Iceland.

CLASS III.

Specific gravity under 1.8. If liquid, the smell is bituminous. If solid, is tasteless.

Order I.—Resin.

Hardness = 0, —2.5. Sp. gr. =0.7, —1.6. If sp. gr. =1.2, and more, the streak is white or grey.

Genus I.—Mellite, or Honey-Stone.

Melichron-Resin, *Mohs.*

Pyramidal. Hardness =2.0, —2.5. Sp. gr. = 1.4, —1.6.

1. *Pyramidal Mellite, or Honey-Stone.*—Jameson.

Pyramidales Melichron-Resin, *Mohs.*—Honigstein, *Werner.*—Mellite, *Hauy.*

Specific Character.—Pyramidal. Pyramid =118° 4′, —93° 22′. Cleavage pyramidal, but imperfect.

Description.—Colours yellow or red. Occurs regularly crystallized and massive. Lustre shining or splendent, and vitreo-resinous. Fracture conchoidal, semi-transparent, or translucent. Brittle.

Geognostic and Geographic Situations.—This rare and remarkable mineral has hitherto been found only associated with brown coal at Artern in Thuringia.

Genus II.—Mineral-Resin.

Erd-harz, *Mohs.*

Amorphous. Hardness =0.0,—2.5. Sp. gr.=0.8, —1.2.

1. *Yellow Mineral-Resin or Amber.*—Jameson.

Gelbes Erd-harz, *Mohs.*—Bernstein, *Werner.*— Succin, *Hauy.*

Specific Character.—Solid. Yellow...white. Streak white or grey. Hardness =2.0, —2.5. Sp. gr. = 1.0, —1.1.

Description.—Colours yellow and white. Occurs massive and disseminated, and often incloses insects, leaves, and other parts of vegetables, also corals, &c. Lustre ranges from splendent to glistening, and is resinous. Fracture conchoidal. Transparent and translucent. Brittle, and easily frangible.

Geognostic and Geographic Situations.—This beautiful mineral occurs in greatest abundance and variety imbedded in the various strata of the alluvial class, and the finest masses are those found in the low, flat, and alluvial countries on the shores of the Baltic. It has been sometimes gathered on the coasts of Scotland and England.

2. *Black Mineral-Resin.*—Jameson.

Schwarzes Erd-harz, *Mohs.*—Bitume, *Haüy.*

Specific Character.—Solid...liquid. Black, brown, red, and grey. Streak black, brown, yellow, and grey. Hardness =0.0, —2.0. Sp. gr. =0.8, —1.2.

Description.—Colours white, grey, yellow, brown,

Mineralogy. and black. Occurs massive, disseminated, globular, reniform, stalagmitic, and liquid. Lustre resinous, and ranging from splendent to glimmering. Fracture earthy, conchoidal, and slaty. Ranges from transparent to opaque.

The yellowish-white, yellowish-grey, and wine-yellow, liquid transparent varieties are named *naphtha*; the blackish-brown, liquid, and translucent or opaque varieties are named *mineral ore, or petroleum*; the blackish-brown solid varieties, with earthy fracture, are described under the name *Earthy Mineral-pitch*; the pitch-black varieties, with splendent and shining lustre and conchoidal fracture, are the *slaggy mineral-pitch, or asphaltum* of authors; and lastly, the brown, massive, curved slaty, and elastic varieties are named *elastic mineral-pitch*.

Geognostic and Geographic Situations.—The naphtha and mineral-oil flow from rocks of limestone and of the coal formations. The finest varieties of the former are found on the shores of the Caspian, the latter occurs at St Catharine's, in the vicinity of Edinburgh, and in several other places in Scotland and England. The earthy mineral pitch is a rare mineral, and has been hitherto found principally in the Hartz; the slaggy mineral-pitch is met with imbedded in the limestone, ironstone, and sandstone of the coal formation in the middle district of Scotland; and the elastic mineral-pitch has been hitherto found only in the lead mine called Odin, to the north of Castletown in Derbyshire.

Order II.—Coal.

Streak brown and black. Hardness =1.0,—2.5. Sp. gr. =1.2, —1.5.

Genus I.—Mineral Coal.

Amorphous. Hardness =1.0, —2.5. Sp. gr. = 1.2, —1.5.

1. *Bituminous Mineral-Coal.*—Jameson.

Harzige Stein-kohle, *Mohs.*

Specific Character.—Colours black and brown. Resinous lustre. Bituminous smell. Hardness =1.0, —2.5. Sp. gr. =1.2, —1.5.

Description.—Colours brown, black, and grey. Occurs massive, ligniform, and rarely in columnar concretions. Lustre ranges from splendent to glimmering, and is resinous. Fracture earthy, conchoidal, slaty, and uneven. Opaque. Streak shining. Sectile or brittle. Easily frangible.

Those varieties of bituminous coal, in which brown is the predominating colour, with feeble lustre, more or less of the woody texture or form, and easily frangible, are named *brown coal*, under which division is included the *fibrous, earthy, aluminous, conchoidal,* and *trapezoidal brown-coal* of authors. The varieties in which the black colour predominates, and the resinous lustre, is considerable, and which are harder than the brown varieties, are named *black-coal*, of which the following kinds are enumerated by mineralogists, viz. *slate-coal, cannel-coal, foliated-coal,* and *coarse-coal.*

Geognostic and Geographic Situations.—The brown coal occurs principally along with rocks of the alluvial class, and the coal of Bovey in England may serve as an example of it in this island; the black-coal never occurs in alluvial formations, always in beds in secondary rocks, and principally in that group or series of strata and beds named the coal formation. The principal coal-mines in Scotland and England are situated in the coal formation. Geognosy

2. *Glance-Coal.*—Jameson.

Harzlose Steinkohle, *Mohs.*—Anthracite, *Haüy.*—Glanzkohle, *Werner.*

Specific Character. — Colour black. Imperfect metallic lustre. No bituminous smell. Hardness =2.0, —2.5. Sp. gr. =1.3, —1.5.

Description.—Colour generally iron-black. Occurs in fibrous and columnar distinct concretions; massive, vesicular, and disseminated. Lustre ranges from splendent to glimmering, and is imperfect metallic or silky. Fracture conchoidal, uneven, and slaty. Opaque. Some varieties soil. The varieties with splendent lustre and conchoidal fracture are named *conchoidal glance-coal*; those with slaty structure *slaty glance-coal*; the columnar varieties *columnar glance-coal*; and the fibrous and soiling varieties *fibrous glance-coal* or *mineral charcoal.*

Geognostic and Geographic Situations.—Glance-coal, like black-coal, occurs in beds in the coal formation in the secondary class of rocks within the middle division of Scotland, and Kilmarnock, Saltcoats, and Sanquhar, may be mentioned as localities; it also occurs in veins and imbedded masses in secondary trap, as in the Calton-Hill at Edinburgh. It differs from the other kinds of coal, by its occasional appearance in rocks of the primitive formation.

New Minerals.

No descriptions are here given of the minerals enumerated in the following list, because, although the accounts of them given by mineralogists are in general correct, they are not complete, and it would have extended this article much beyond the limits precribed to it, to have detailed all that has been published in regard to them.

1. Allophane. 2. Bismuthic silver. 3. Blædite. 4. Brewsterite. 5. Fluat of Cerium. 6. Comptonite. 7. Conite. 8. Cronstedite. 9. Couzeranite. 10. Giesekite. 11. Gismondite. 12. Heulandite. 13. Hisengerite. 14. Humite. 15. Ligurite. 16. Mellite. 17. Molybdenic silver. 18. Orthite. 19. Polyhallite. 20. Pyrallolite. 21. Pyrorthite. 22. Pyrosmalite. 23. Sapparite. 24. Skorodite. 25. Spinellane. 26. Stilpnosiderite. 27. Sordawallite. 28. Thomsonite. 29. Wavellite. 30. Yttrocerite. 31. Zurlite.

Plates.

The figures in the Plates of Mineralogy, from fig. 27 to fig. 46, refer to the cleavage of minerals. Plates.

GEOLOGY.

Geology, as already mentioned, is that branch of mineralogy which treats of the atmosphere, the waters of the globe, and of the mountain rocks, of which the earth is composed. The natural history of the atmosphere is given in the article Meteorology, and that of the waters of the globe under various heads of the *Encyclopædia*, as Ocean, Springs, History of this Branch of Science.

Fig. 1

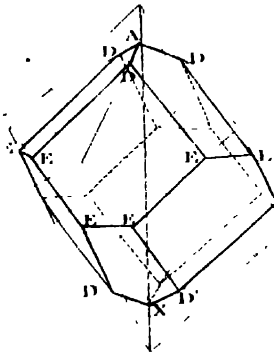


Fig. 2

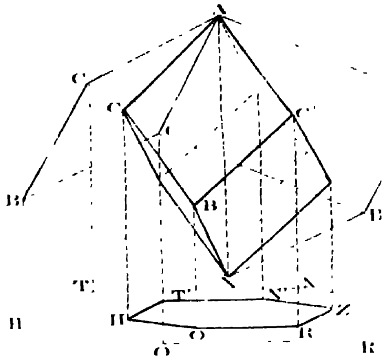
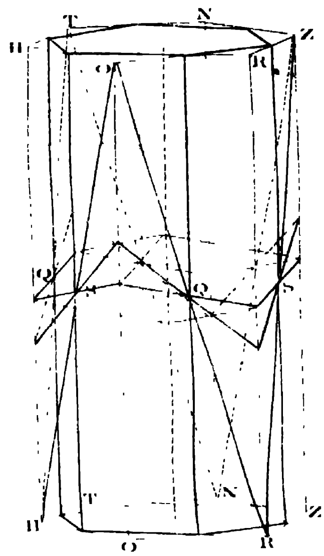


Fig. 3



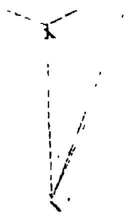


Fig. 6

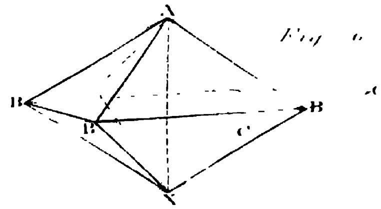


Fig. 8

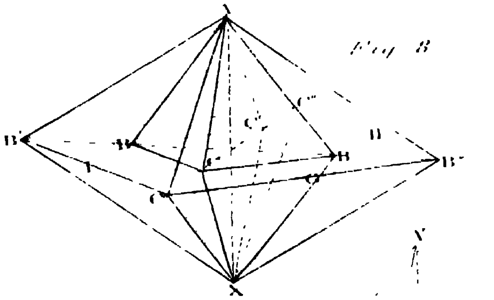


Fig. 9

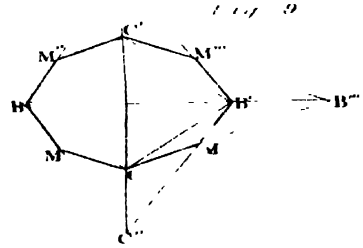


Fig. 7

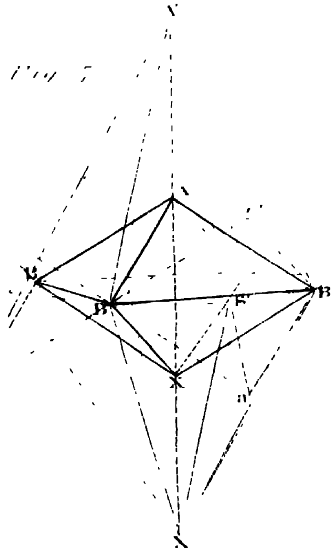


Fig. 10

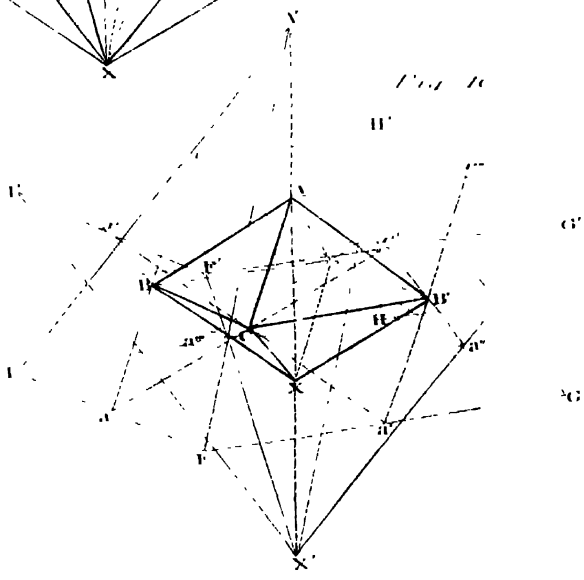


Fig. 26

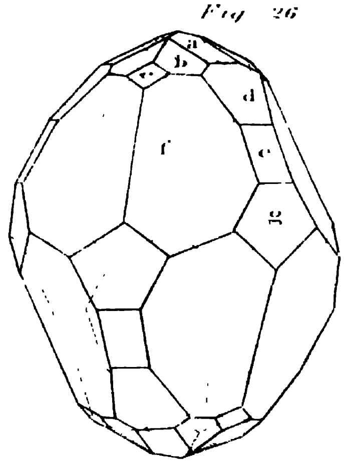


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Fig 11

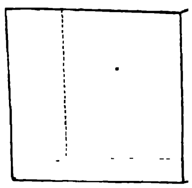


Fig 12.

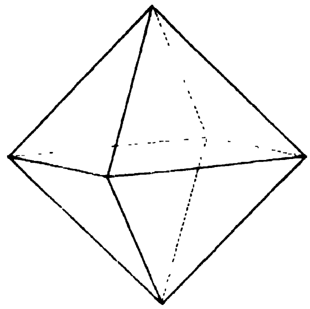


Fig 13

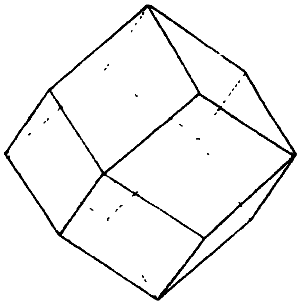


Fig 14

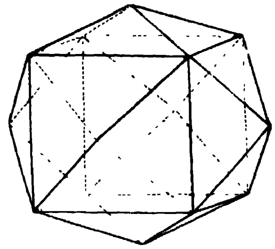


Fig 15

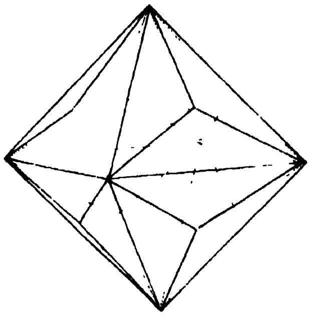


Fig 16

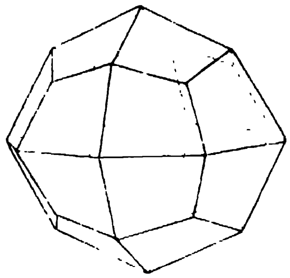


Fig 17

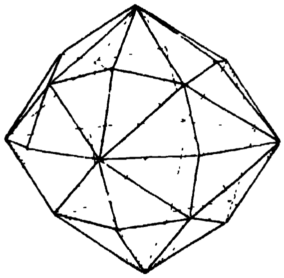


Fig 18

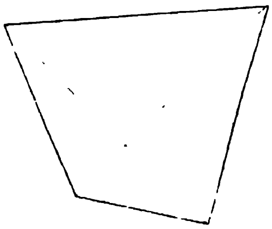


Fig 21

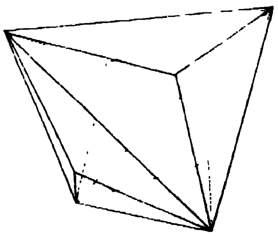


Fig 20

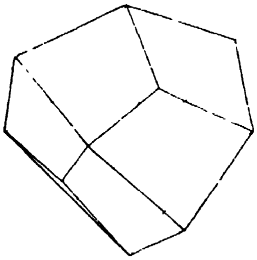


Fig 19

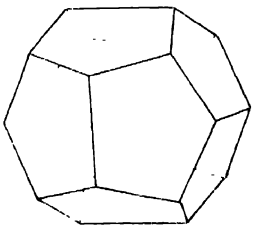


Fig 23

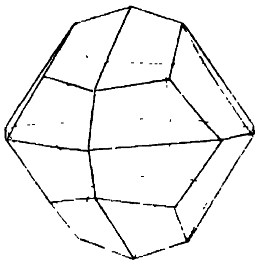


Fig 22

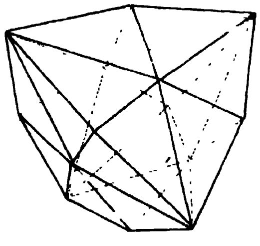


Fig 24

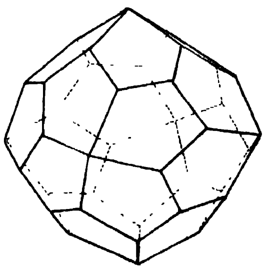


Fig 25

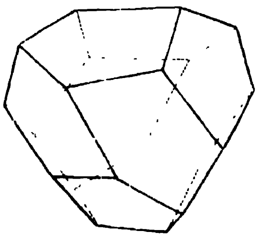


Fig 27

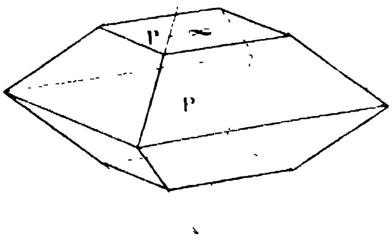


Fig 28

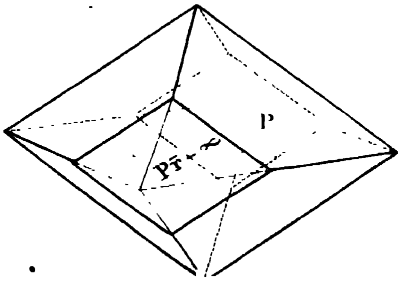


Fig 29

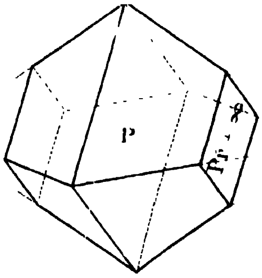
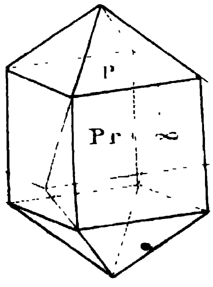
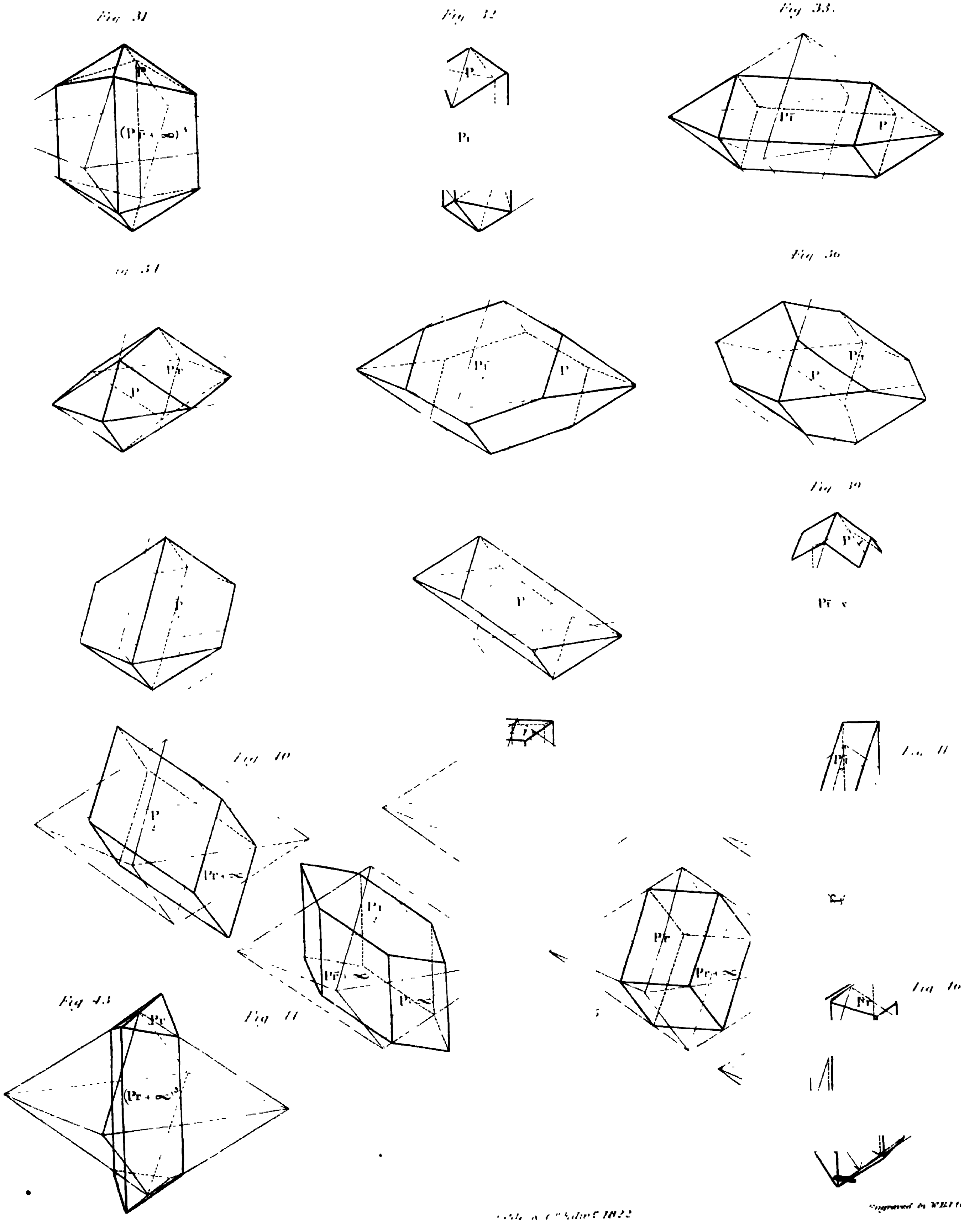


Fig 30



MINERALOGY PLATE C.



Geognosy.

Lakes, Rivers, &c.; and therefore our present business is with the natural history of the solid materials, of which the crust of the earth is composed. This particular department of geology is now generally known under the title Geognosy; and may be defined as that branch of mineralogy which makes us acquainted with the physiognomy of the earth's surface, and also with the internal structure, relative position, and mode of formation of the mineral masses of which it is composed.

Geognosy had scarcely an existence before the time of Saussure and Werner. The former of these celebrated philosophers, as Cuvier remarks, "by a laborious investigation of the most inaccessible mountain districts during twenty years of continual research, in which he examined the Alps on all sides, and penetrated through all their defiles, has laid open to our view the entire order of the primitive formations, and has clearly traced the boundaries by which they are distinguishable from the secondary formations. The other equally celebrated geologist, taking advantage of the numerous excavations in the most ancient mining district in the world, has fixed the laws which regulate this succession of strata, pointing out their relative antiquity in regard to each other, and tracing each of them through all its changes and metamorphoses. From him alone we date the commencement of real geognosy, so far as respects the mineral natures of the strata." Cuvier ranks next to the illustrious naturalists just mentioned. His numerous discoveries in the natural history of fossil organic remains; his inquiries into their distributions in the various mineral formations, and his elegant general views, have added much to the natural history of the globe, and contributed in an eminent degree to the advancement of geognosy. Hutton, our distinguished countryman, by the boldness and originality of his speculative views; Whitehurst, by his accurate and interesting descriptions; Playfair, by the publication of his splendid illustrations of the Huttonian theory; Greenough, Buckland, Macculloch, Jameson, and many others, by their investigation of the interesting mountains and plains of Great Britain; and the united efforts of the Wernerian Society of Edinburgh, and of the Geological Societies of London, Cornwall, and Cambridge, have, in a wonderfully short period of time, not only very greatly extended the boundaries of this science, but procured for it a host of active and intelligent cultivators; so that, at present, it is, of all the branches of natural history, that which is the most enthusiastically pursued in this island.

The principal details and theories connected with geognosy having been already given in a previous article, we shall at present confine ourselves to a short description of the physiognomy of the earth's surface; of the changes it has experienced through the agency of the atmosphere, and water; and conclude with a general account of the rocks of which the earth is composed.

Geognosy.

I.—Physiognomy of the earth's surface, or description of the various inequalities observable on the dry land, and on the bottom of the sea.

On a very general view, the surface of our globe appears arranged into land and water. The water occupies nearly three-fourths of its surface, and the dry land (above its level) is arranged into masses of various forms and magnitudes. This dry land is not equally distributed; for a much larger portion of it occurs to the north than to the south of the equator; and the difference in this respect is so great, that the southern half is principally water, while the northern is chiefly land.

This great accumulation of land in the northern half of the globe suggested to some geographers the idea of the existence of a southern continent, which was necessary to counterbalance the mass of land situated in the northern hemisphere. The discoveries of Cook, however, have shown, that, up to the 70° south latitude, there is no appearance of continent; and that these dreary regions of water and ice are only diversified by a few islands. Beyond this limit, towards the pole, there remains only about five or six hundred thousand square marine leagues, in which there can be any land, inaccessible to navigators, on account of the ice, but the whole of this mass would slightly alter the proportion between the two hemispheres.* But the part of the land above the surface of the sea is so small, in proportion to the whole mass of the globe, that the effect of its unequal distribution upon the equilibrium of the globe is so inconsiderable, as to produce no sensible effect.

The dry land is arranged into two grand divisions, named *Worlds*, viz. the *Old World*, and the *New World*. The *Old World*, in the eastern hemisphere, extends from south-west to north-east, and comprehends the three continents, viz. Africa, Asia, and Europe. The *New World*, in the western hemisphere, extends from north to south, and is composed of two continents, viz. North and South America.

The old and new worlds have the following feature in common—northern and southern halves, connecting isthmuses, a peninsula on the one side, and a group of islands on the other. This arrangement will appear evident from the following details:

The old world may be considered as composed of two great halves, whose greatest direction is from north to south; the one, the western, includes Europe and Africa; the other, the eastern, Asia and New Holland. In the western half, the two parts or continents, viz. Europe and Africa, are connected together by the Isthmus of Suez, and have, on the one hand, the Islands of the Mediterranean, and on the other the Peninsula of Arabia. In the eastern half the two continents of Asia and New Holland are, to a certain extent, connected together by the Islands of Java, Sumatra, &c.; and in front of this broken isthmus is Papua and other islands, and on the opposite side the Peninsula of India. The new

* The lately discovered islands to the south of Cape Horn, named New South Shetland, were at first considered as portions of a *Terra Australis*.

Geognosy. world is composed of two halves, a northern and southern; these are connected together by the Isthmus of Darien, and on the front are situated the West India Islands, and behind the Peninsula of California.

Another general feature in the distribution of the dry land is the tending of all the great peninsulas towards the south. This is the case with Africa, Arabia, India, South America, Scandinavia, Spain, Italy, Greece, Corea, Alashka, Kamschatka, California, Florida, and Greenland.

Besides the old and new worlds, in the sense above described, there occur, dispersed through the ocean, numerous smaller masses of land, forming islands of various magnitudes and forms. Those islands, situated near to the continents, are considered as belonging to them. Thus, the British Isles belong to Europe, those of Japan to Asia, the West India Islands to America, and Madagascar to Africa. But there are other islands situated at a distance from continents, and which cannot be referred to any of the preceding divisions, but to the oceans in which they are situated.

Such are the general distributions of the land above the level of the sea; that below the waters of the ocean, or the *submarine land*, presents considerable variety in form and in distribution, as we shall explain particularly afterwards.

Inequalities of the Surface of the Dry Land.

The surface of the dry land exhibits great variety in aspect, forming mountains, hills, valleys, and plains. The most general divisions of these inequalities, established by geographers, are into *high land* and *low land;* and the more particular into *mountain groups, hilly land, mountain chains, mountains, plains*, and *valleys*.

High Land and Low Land.

The surface of the dry land, on a general view, may be considered as composed of *high land* and *low land*. By the first we understand a lofty, uneven, and widely extended mass of land; by the second, a great and widely extended low and flat country. These high and low lands occur in all the great continents already enumerated. Thus, in Europe there is one extensive low land, bounded by two or three great high lands, which lie to the north and to the south. The southern high land has its central part in the Alps, to the east of Switzerland; towards the west it extends to the Atlantic Ocean, towards the east to the Black Sea. The northern high land comprehends the great range of Britain, that of Sweden and Norway, and some ranges in European Russia, which connect the lofty land of Norway with the Uralian range. It is between these high lands that we find the great European *low land*, which comprehends the northern part of France, the Netherlands, Holland, Lower Germany, Silesia, Poland, and the greater part of European Russia, to the foot of the Uralians.

High Land.

These high lands are composed of chains of mountains, variously arranged in regard to each other, and to a central and high chain; and the numerous concavities and hollows between these chains and mountains form the different kinds of valleys. Interposed between these and the low land are ranges of lower hills, forming what is called *hilly land*. In order to obtain a clear notion of the structure of the high land, it will be advantageous to premise a short account of the forms of single mountains, and of chains of mountains.

1. *Single Mountains.*

In single mountains, or hills, we can, in general, distinguish three different parts, named the foot, acclivity, and summit.

Foot.—The foot is the lowest and flattest part. It sometimes extends to a considerable distance, and then rises under an angle of 8° or 10°; when it is less extensive, or has a smaller base, it rises under a somewhat greater angle, but never greatly exceeds 10°. The mountains in wide valleys have generally a considerable foot, but in those in narrow valleys the foot is less in extent. Sometimes, as in mountains having a *mural* ascent, there is no foot. The inconsiderable inclination of the foot of mountains is owing to the extensive cover of debris, or alluvial soil, spread over them.

Acclivity or Ascent is the space between the foot and summit of a mountain. It is generally the steepest and most considerable part of it. Its inclination is less or more than 30°, and on this depends the greater or less depth of the soil. Upon an acclivity of 30°, and even more, we find a good cover of soil; at 45°, however, the acclivity is too great to admit the growth of trees. Sometimes the acclivity is perpendicular, forming mural precipices; and it is either mural on one, two, or all sides, or in single spots. Granite, porphyry, and sandstone, afford examples of such acclivities. Humboldt remarks, in regard to acclivities in general, that they are to be reckoned considerable when their angle is 7° or 8°, which is the maximum for carriages; that they are very steep when 15°, which is the maximum for loaded beasts of burthen; that an inclination of 35° is so great, that we cannot ascend it without cutting steps in the rocks; and that, even with the aid of steps, an inclination of more than 44° is very difficult of ascent.

Summit is generally the smallest part of a mountain, and is less steep than the acclivity. There occur, however, exceptions to this: thus, there are summits that rise more rapidly than the acclivity; and these are usually very high, almost of equal height with the acclivity, and completely bare. Summits of this description are frequent in Switzerland, where they are named *peaks*. In Switzerland, many of the summits are very narrow, high, and sharp, and are named *needles*. When the peaked or sharp conical form becomes more obtuse, *obtuse conical* summits are formed. When the cones become very flat and roundish they resemble domes, and such summits are said to be *dome-shaped*. Many summits have a convex or obtuse ridge-form, and these are named *round-backed*, and not unfrequently the summit is flat and like a table, when it is said to be *table-shaped*. These various forms of the summit

depend, in some measure, on the nature of the rocks; thus, soft and easily decomposible rocks present a soft outline, while those composed of hard and difficultly decomposible rocks have a very uneven and sharp contour. The position of the strata also materially affects the forms of summits, for it frequently happens, that vertically disposed hard strata form peaks and needle summits, while horizontal strata form tabular summits. The vertical strata of gneiss in some districts in Scotland, afford fine examples of the peaked and denticulated summits, some of the softer granites of Aberdeenshire of the obtuse conical summits, the clay-slate of the outer ranges of certain Highland districts of the round-backed summits, and the hills of the secondary trap formation, and of some sandstones, the table-shaped summit.

II.—*Chains of Mountains.*

When a greater or lesser number of hills or mountains are connected together in a lengthened form, and in a single series, they are said to form a *chain of mountains*. It seldom happens that single chains of mountains occur in a country, they being generally more or less numerous, and variously aggregated together.

III.—*General Description of a Mountain Group, or Alpine Group.*

In the higher and more central parts of the high land, many chains of mountains occur together, and in a determinate order, and form what may be denominated a *mountain group*, or *alpine group*, or system or mass of mountains. When a mountain group is viewed as a whole, it appears highest in the middle, and this highest part extends through the whole group, without being in any part of its course intersected. This elevated part we denominate the *high mountain chain;* it is the *faite* of French geologists; the *juga montium, serre* and *sierra*, of geographers.

The transverse section of a mountain group has, in general, a triangular form, in which the height bears a small proportion to the base. The two sides of the triangle form what are termed the *acclivities* of the group; their intersection at the upper edge, the *high mountain ridge;* the inferior part of each inclined plane, the *foot* or bottom of the group; the two small faces (the ends of the prism), the *extremities* of the group; its *length* is the distance from one extremity to the other; its *breadth* is that across from one foot to the other; and the *height*, the vertical elevation from the high mountain ridge to the level of the sea; and lastly, the point of the compass, towards which the high mountain ridge is directed, is the *direction*. On each of the acclivities there are chains of mountains which shoot from each side of the high mountain chain, in the manner of the ribs from the vertebral column of an animal. Between these chains, which become lower as they approach the foot of the group, are situated those great hollows or concavities named *principal valleys*. Some chains take their rise at the high mountain ridge, and terminate in the principal valley, before they reach the foot of the acclivity; others rise in the middle of a principal valley, and terminate at the foot of the group; and this arrangement gives rise to short valleys, having the same direction as the principal valleys, and contained in them. The acclivities of two opposite chains, which form the sides of the same valley, meet together, in a more or less tortuous line, in the bottom of the valley, or in what is termed by continental geographers the *thalweg*. The principal valleys, at their upper extremity or at the point of their origin, terminate in a roundish hollow which cuts the high mountain chain, and which is termed a *gorge* or *pass*. Between any two adjoining gorges, the high mountain ridge retains its primitive height, and forms a protuberance or *summit;* so that a high mountain chain, in its line of direction, appears denticulated or composed of an alternating series of gorges and summits. The gorges or passes are the points of departure of any two valleys on opposite sides of the group; and the summits are the points of departure of any two opposite chains. The principal mountain chains just described are again connected with others which proceed from them in a perpendicular direction; these form what are termed *secondary chains*, and the hollows or valleys between them *secondary valleys;* from these secondary chains others proceed, and give rise to *tertiary chains*, and *tertiary valleys*. Many valleys of a *fourth*, and even of a less considerable magnitude, occur, which do not require any further description.

IV.—*Particular Description of a Mountain Group, or Alpine Group.*

a. *Water-Shed.*

The summit of the high mountain chain is, as already mentioned, named the *high mountain ridge*. It is the *water-shed* for the whole group, and is the line formed by the meeting of the two acclivities. French geologists term it *ligne de partage des eau;* German geologists named it *wasser scheide;* and by geographers it is named *divortia aquarum*. The exact determination of this line is often of great importance; for example, when it is to be taken as the boundary of two neighbouring states, as was the case in the treaty of the Pyrenees (art. 42), where it was stipulated that the water-shed was to serve as the boundary between France and Spain. We must not, however, believe that the water-shed is always the highest part of a mountain group; for, as we shall afterwards explain, some of the subordinate ranges are occasionally considerably higher.

On crossing the high mountain ridge, we often pass immediately from the one acclivity of the group to the other; but in other cases, the high mountain summit is very broad, and when this takes place, we have a distance of several miles, or even leagues, before we cross from one acclivity to the other. Thus in the great alpine country of Norway, named the *Lange Field*, the summit of the high mountain chain varies in breadth from 24 to 36 miles. Mexico also presents a striking example of a summit which has a breadth and a length of many leagues. But even in these summits, or *alpine platforms*, or *table lands*, there is a water-shed; and it is this line which represents in every case, correctly considered, the

geometrical summit of the group. In some mountain groups, as the Grampians and the Pyrenees, the high mountain chain has the same general direction from one extremity to the other; in other cases, there is a change of direction; thus the Alps, after ranging from W. S. W. from St Gothard to beyond Mont Blanc, turn suddenly to the south, and maintain their new direction to the shores of the Mediterranean. During the different changes in the direction of the high mountain chain, it experiences considerable variation in height, becoming very low in some parts of its course.

b. *Acclivities.*

The inclined planes that proceed from each side of the high mountain chain are, as formerly mentioned, named the acclivities of the mountain group. The angle of inclination of the acclivities varies from 2° to 6°; thus that of the northern acclivity of the Pyrenees is from 3° to 4°; that of the southern acclivity of the Alps, from the line formed by the colossal summits of Mont Blanc, Mont Cerven, and Mont Rose, and of which the general height is 3500 metres, to the plains of Piedmont and Lombardy, is 3¾°. But as such a general inclination is made up of many particular inclinations, on account of the irregularities of the acclivity, we must, before we reach the summit, ascend and descend acclivities much more considerable than that we have just mentioned. The two acclivities of a group have seldom the same degree of inclination; on the contrary, the one is generally shorter and steeper than the other. Thus the western acclivity of the Grampian mountain group is steeper and shorter than the eastern; the northern acclivity of the Erzgebirge is long and gentle, while the southern is rapid and short; in the Pyrenees, the northern acclivity is more extensive and steeper than the southern; and the western acclivity of the Andes is shorter and steeper than the eastern. These differences of inclination of the acclivities have long engaged the attention of observers, and they have endeavoured to discover some law to which they may be referred. Bergman, in his *Physical Geography*, maintains, that in chains having a north and south direction, the western acclivity is always the steepest; and that in chains ranging from east to west, the southern acclivity is the steepest. Dr Walker also maintained the same opinion, and used to refer to the phenomena in the Highlands of Scotland for illustrations of its truth. There can be no doubt of this arrangement occurring in some groups, but it is by no means a general one.

Andreossy, the celebrated engineer, remarks, "That when ranges of mountains are situated on the acclivities of a mountain group, such as the Jura, Vosges, Cevennes, situated on the grand acclivity descending from the Alps to the ocean, that the acclivities of the ranges looking toward the upper part of the acclivity of the group are the most abrupt;" he names it *contre-pente*, in opposition to the other acclivity, which being inclined in the direction of the general acclivity of the chain, bears the name simply of *penté* or acclivity. The observations of Saussure accord with this statement, for he says, "The interior chains turn their back to the exterior parts of the Alps, and present their escarpement to the central chain." It has also been remarked, that the mountains immediately around lakes, as those around the lake of Geneva, have their escarpement, that is, their most abrupt face, toward the lake.

c. *Lateral and Subordinate Chains.*

Those chains, which are situated on the acclivities of the group, present nearly the same phenomena as the high mountain chain. The ridges of these chains, on a general view, diminish in height as they approach their termination; but this is not always the case, because we sometimes find them maintaining their original height for a great length, and sometimes terminating abruptly. These lateral ranges also sometimes rise to a greater height than the high mountain range; thus the highest summits in the Pyrenees are not in the high mountain chain, but at a distance from it: Mont Perdu, the highest summit in the Pyrenees, is not in the high mountain chain, but in one of the lateral chains. These lateral chains have others rising from them under various angles, and thus forming another series of valleys, and these again, in their turn, in a similar way, give rise to still smaller chains and valleys.

d. *Mountain Arm.*

Sometimes a lateral branch or chain passes on from the foot of the acclivity into the bounding low country, and then forms what is called a *mountain arm*; and which, if continued to the sea, and terminates abruptly, forms a *cape* or *promontory*. In other cases, on the contrary, one of the lateral chains does not reach the foot of the mountain group, but terminates at a greater or less distance from it, and thus leaves an empty space between the extremities of two lateral chains, which are to the right and to the left of it. If the sea washes the foot of the mountain group, it invades the space between the two chains, and forms a *gulf*.

e. *Valleys.*

The concavities or hollows in a mountain group are denominated *valleys*. These are of various magnitudes. The principal or largest valleys are those that rise towards the high mountain chain, and which descend from it in a direction nearly perpendicular to its direction, and terminate at the foot of the group. Their general position is across the acclivity; hence they are sometimes named *transverse valleys*. They receive from their right and from their left, and nearly perpendicular to their direction, the valleys of the second order; and these latter valleys receive, in their turn, the valleys of the third order, or the branches of the third order, and so on of the other branches and valleys of smaller dimensions.

f. *Bottom of Valleys.*

As we ascend in valleys towards the chains from which they take their rise, we find that the inclination of the bottom is not every where uniform. The inclination is usually uniform and gentle, until we reach the ramifications at its upper part, when it

increases considerably, and sometimes we cannot reach the mountain chain but by a very steep ascent, sometimes, indeed, nearly vertical, so that the valley seems to terminate suddenly opposite to a perpendicular face. Examples of these appearances on the small scale occur in Glen Cloy, in the Island of Arran, and in Glen Corse, near Edinburgh. Beyond these precipices, in some valleys, in following the course of the water, the valley contracts and again enlarges, and this several times before reaching its termination. Most of the larger valleys present, in their course, a series of contractions and enlargements, thus forming a series of basins ranged in stages, the one above the other, and seldom communicating but by narrow openings. The valleys in the course of the Don, in Aberdeenshire, Beauly, in Inverness-shire, Tay, in Perthshire, and Nith, in Dumfries-shire, are of this description. Saussure describes several basins as occurring in the valley of the Rhone; the large and beautiful valley of Aosta, according to Daubuisson, has three basins; and the valley of the Nile, in Upper and Middle Egypt, presents a series of similar basins.

g. *Salient and re-entrant Angles of Valleys.*

Another curious phenomenon exhibited by valleys is their salient and re-entrant angles. "We see, in the Pyrenees," says Raymond, "some valleys whose salient and re-entrant angles so perfectly correspond, that if the force which separated them were to act in a contrary direction, and bring their sides together again, they would unite so exactly, that even the fissure could not be perceived." This appearance was first particularly noticed in the Alps by Bourguet.

h. *General Direction of the great Valleys of a Group.*

The direction of the principal valleys of a group, as we have already explained, is nearly perpendicular to the high mountain chain; and it is in consequence of this that valleys of this description, on a general view, and independent of local deviations, are ranged in the line of dip of the greatest acclivity. The Grampians in Scotland, and the Pyrenees in Spain, afford illustrations of this fact. But at the extremities of a high mountain chain, when the ridge becomes low, and does not rise again, the valleys ought to diverge round the point where the sinking begins; they are no longer perpendicular to the high mountain chain, and may become parallel to it. Examples of this arrragement occur in Scotland. Andreossy, speaking of such an appearance, says, "that when valleys are disposed in this manner, the mountain group to which they belong may be considered as terminated."

k. *Gorges or Passes.*

These are the small valleys or hollows in the high mountain chain. As these are the lowest points on the summit line of a high mountain chain, they will form the lines of communication between two countries separated by a mountain group. Notwithstanding their low situations, in regard to the neighbouring heights, they are nevertheless highly elevated above the level of the sea. The great passes leading from France into Italy afford striking examples of these short valleys; one of these, the great St Bernard, is 2500 metres above the sea; the little St Bernard, another pass, is 2200 metres above the sea; and a third, Mount Cenis, is 2060 metres above the level of the sea.

l. *Forms of Mountain Groups.*

The general aspect of a mountain group depends very much on the shape of the summits of the mountains of which its various chains are composed. Each group is in some degree characterized by these: In this view mountain groups are divided into *common, conical,* and *alpine.* In the *common mountain group,* the individual mountains of which the chains are composed are joined nearly by the summits. In the *conical mountain group,* the individual mountains of which the chains are composed are also singly aggregated, but not joined higher up than the acclivity; so that they appear conical. In the *alpine mountain group,* the mountain chains are composed, not of single mountains joined together, but of groups of pyramidal-shaped mountains, in which groups a large pyramidal mountain has arranged around it a number of smaller mountains of the same figure.

m. *Connections of Mountain Groups.*

Mountain groups seldom occur isolated, as is the case with the Grampians and the Pyrenees; more generally several occur together, and when this is the case, we observe that they are connected together or separated from each other in various ways. Sometimes they are separated from each other by seas; it is thus that the extremity of the Alps of Europe, or Mount Hæmus, is separated from the Caucasus by the Black Sea. In other cases they are separated by plains, placed between the foot or the extremities of the groups, as is the case with the Alps of the Tyrol, which are separated from the Böhmerwald and other mountains of Bohemia, by the plains of Bavaria. Principal valleys sometimes form the limits between two mountain groups; thus the Cevennes group is separated from the French Alps by the valley of the Rhone. Small groups of hills occasionally form the boundaries: it is thus that the Vosges are separated from the Jura group, and the Pyrenees from the Cevennes. Lastly, mountain groups are separated by natural sections; in this way the Jura group is separated from the French Alps by the deep and narrow ravine near the Fort of Ecluse.

n. *Series of Mountain Groups.*

Mountain groups, in regard to their connection, are either *isolated,* or several are joined together, forming a *chain* of mountain groups. A chain of mountain groups extends from the Alps of Switzerland to Servia and Bulgaria; a similar range is formed by the Fichtelgebirge, which is connected with the Carpathians by the mountain groups of the Erzgebirge, Riesengebirge, Silesian, and Moravian groups.

o. *Direction of Mountain Groups.*

The direction of mountain groups, and of chains

Geognosy. of mountain groups, is the same as that of the greatest dimension of the continent or island in which they occur. Thus, in Scotland, the high land, extending from Dumbarton to Cape Wrath, is in the direction of its greatest dimensions, which is from N. to S.; in the mainland of Shetland, the principal group is also in the direction of its greatest length; and in Norway, the great high land ranges from north to south, in the direction of its greatest length.

p. *Basins and Lakes in Mountain Groups.*

Numerous basins or concavities among mountains are filled with water, forming lakes, while others are without water, or empty. These lakes are met with principally at the foot of mountain groups, or near to their high mountain chain,—that is, at the upper extremity of the principal valleys, very near the gorges or passes. There are lakes at the highest points of the three grand passes from France into Italy by Mount Cenis, the little St Bernard, and the great St Bernard; the first is half a league in length, and the latter has a contour of three or four miles. In the valleys in the interior of mountain groups many basins occur, placed in succession above each other; and the same disposition is seen in the great valleys of rivers, far from the centre of mountain masses.

V. *Hilly Land*

Is composed of ranges of hills, which are irregularly grouped together, and whose elevation, in general, does not exceed 1000 feet. There is no central, or high mountain chain towards which the others tend. It forms the link which connects the mountain group with the low land, and often there is a gradual lowering of the hills until they are lost in the plains.

Low Land.

The low land is formed principally of large and extensive plains, little elevated above the level of the sea, on which we occasionally observe gentle risings and undulations of the surface, that often extend to a considerable distance, and sometimes form the limits between neighbouring rivers.

The plains of the low land are characterized by the presence of particular hollows, or concavities, which are denominated *river-valleys*, or *river-courses*. In these, there are to be distinguished the *bed* of the river, and the *holm*, or *haugh* land: Further, there are to be observed the *high* and *low* bank of the river, and the ravines, or small valleys, that traverse the high bank and terminate in the low bank. There is still another kind of hollow met with in *low* land; it is that formed by shallow and wide extended lakes. Numerous instances of this appearance occur in the great European low land.

Before proceeding to describe the forms of the submarine land, we shall give descriptions of *coasts* and *caves*.

Coasts.

The edge of the dry land, where it meets the waters of the ocean, has received the general name of coast. It varies in its aspect. Sometimes it is formed of steep and rugged rocks, which are either low, or rise to considerable height; in other cases, it is composed of shelving irregular rocks; on the coast of Holland, and in other countries, it is formed of low sandy hills termed *dunes*; and lastly, in the tropical seas it is more or less deeply incased with corals of various descriptions, forming what are called *coral-reefs*. Geognosy.

Caves.

These are cavities of greater or less extent, which are either open to day, or are more or less completely concealed in the interior of the earth. They are divided into *external* and *internal caves*.

1. *External Caves.*—These are great hollows open to day, and which occur in the faces of cliffs on the sides of valleys, and in steep cliffs and precipices near the coast, or which hang over the sea. Limestone and sandstone cliffs and precipices often exhibit caves of this description, and similar caves, sometimes of great magnitude, occur in primitive and transition rocks. The great open caves on the west coast of the Island of Arran are situated in sandstone, and the same is the case with those on the coast of Fifeshire and Angus-shire; the striking cave of Smoo, in Sutherland, is in limestone, and those of the Islands of Isla and Jura are in primitive rocks.

2. *Internal Caves.*—These are situated either in the centre of mountains, and without any direct communication with the atmosphere, or they are situated in the interior of rocks, but communicate with the external air by means of passages of greater or less extent. Completely included caves, and sometimes of great extent, occur in limestone, gypsum, and porphyry rocks, and others communicating by means of passages with the external air in granite, trap, and limestone rocks. The grotto of Antiparos, the caves of Derbyshire, those in several of the Hebrides, as Maclean's Cave, in the Island of Egg, &c. and some caves in the south coast of Fifeshire, are of this description.

Submarine Land.

The bottom of the sea, like the surface of the dry land, exhibits considerable variety of aspect. In some seas there occur flats and plains ranging to a considerable extent, and near to the surface of the water, forming what are named *shoals*; in other cases, plains of great extent occur deeply seated, or far under the surface of the ocean, and are denominated *deep submarine plains*. These submarine plains, like the plains on the dry land, sometimes contain hollows of considerable extent, and of great depth, which have not received any particular name. Mr Stevenson's interesting map of the German Ocean, in the third volume of the *Memoirs of the Wernerian Natural History Society*, presents an accurate view of the submarine plains and hollows of that part of the ocean. These submarine plains are often varied by the appearance of hilly ranges corresponding with those on the dry land.

In the tropical seas, by the accumulation of corals, numerous inequalities are formed in the submarine lands. The coral surface is always very rough and sharp, and when near the surface of the water, forms *coral-reefs* and *coral-shoals*. Sometimes the

inequalities are so considerable, as to form ranges of submarine *coral-hills*, or the rough, sharp, and rugged surface extends to a vast distance in the form of *coral-plains*.

II. Changes induced on the Surface of the Earth by the Destroying and Forming effects of Water and the Atmosphere.

Having now enumerated and described the various inequalities observable on the surface of the dry land and the submarine land, we shall next give an account of the changes they have undergone by the agency of the waters of the globe and the atmosphere.

Action of Water.

Water, Werner remarks, acts mechanically, when it removes part of the soil over which it passes or corrodes the channel in which it flows, or the reservoirs in which it is contained; it also acts mechanically, when, on being imbibed by rocks, it increases their weight, and thus favours their rending, slipping, and overturning; and lastly, it acts mechanically, when, by its freezing in fissures, it breaks up mountain masses and rocks.

It acts chemically when it dissolves particular mineral substances out of the rocks through which it percolates.

Destroying Effects of Water.

I. *Mechanical Destroying Effects of Water.*

1. *Rain water*, when it first touches the surface of the earth, simply moistens it: on sinking deeper, it supplies springs; and if the fall is violent, as is the case in thunder-storms and water-spouts, much of the soil is carried away, and considerable tracts are in this way bared to the naked rock. The rain water, in its progress towards the lower parts of the earth, flows either into ravines, and from these into valleys and beds of rivers; or when it meets with no furrow or ravine, scoops out a bed for itself. Torrents, when they descend from the sides of mountains, and even where the declivity of their course is not very great, produce effects which nothing but direct experience could render credible. "The fragments of rock," Professor Playfair remarks, "which oppose the torrent, are rendered specifically lighter by the fluid in which they are immersed, and lose by that means, at least, a third part of their weight; they are, at the same time, impelled by a force proportional to the square of the velocity with which the water rushes against them, and proportional also to the quantity of gravel and stones which it has already put in motion. Perhaps, after taking all the circumstances into computation, in the midst of a scene perfectly quiet and undisturbed, a philosopher might remain in doubt as to the power of torrents to move the enormous bodies of rock which are seen in the bottom of the narrow valleys or deep glens of a mountainous country; but his incredulity, says an experienced traveller, will cease altogether, if he has been surprised by a storm in the midst of some alpine region; if he has seen the number and impetuosity of the cataracts which rushed down the sides of the mountains, and beheld the ruin which accompanied them; and if, when the tempest was passed, he has viewed those meadows, which a few hours before were covered with verdure, now buried under heaps of stones, or overwhelmed by masses of liquid mud, and the sides of the mountains cut by deep ravines, where the tract of the smallest rivulet was not to be discovered."

2. *Rivers.*—These occasion considerable changes in their passage from the mountains to the low country, by corroding the sides of their beds, and by breaking down their banks; and this mechanical agency is much increased when they carry along with them gravel and rolled stones. It is towards the upper part of the channels of rivers that we observe with the greatest distinctness their mechanical destroying effects on the *solid strata*. Professor Playfair remarks, that it is not in the greatest rivers that the power to change and wear the surface of the land is most clearly seen. It is at the heads of rivers, and in the feeders of the largest streams, when they descend over the most rapid slope, and are most subject to irregular or temporary increase and diminution, that the causes which tend to preserve, and those that tend to change the form of the earth's surface, are farthest from balancing one another; and where, after every season, almost after every flood, we perceive some change produced for which no compensation can be made, and something removed which is never to be replaced. When we trace up rivers and their branches towards their source, we come at last to rivulets, that run only in time of rain, and that run dry at other seasons. The changes of the valley of the main river are but slow; the plain indeed is wasted in one place, but is repaired in another, and we do not perceive the place from whence the repairing matter has proceeded. That which the spectator sees here does not therefore immediately suggest to him what has been the state of things before the valley was formed. But it is otherwise in the valley of the rivulet; no person can examine it without seeing that the rivulet carries away matter which cannot be repaired, except by wearing away some part of the surface of the place upon which the rain that forms the stream is gathered. The remains of a former state are here visible; and we can, without any long chain of reasoning, compare what has been with what is at this present moment. It requires but little study to replace the parts removed, and to see nature at work, resolving the most hard and solid masses, by the continued influences of the sun and atmosphere. We see the beginning of that long journey by which heavy bodies travel from the summit of the land to the bottom of the sea. In the lower and flatter districts where the strata are soft and yielding, the mechanical destroying effects of the water of rivers are often on an extensive scale. It is particularly striking when rivers pass through alluvial depositions, when they show by the successive banks and terraces on their sides the great depth to which they have worked. The alluvial matter, thus removed by the river, appears in many cases to have been deposited from the waters of lakes and the rivers con-

Geognosy. nected with them. The courses of many rivers, as Professor Playfair observes, retain marks that they once constituted a series of lakes, which have been converted into dry ground, by the twofold operation of filling up the bottoms, and deepening the outlets. This happens especially when successive terraces of gravelly and flat land are found on the banks of a river. Such platforms, or *haughs*, as they are called in this country, are always proofs of the waste and *destruction* produced by the river, and of the different levels on which it has run; but they sometimes lead us farther, and make it certain that the great mass of gravel which forms the successive terraces on each side of the river was deposited in the basin of a lake. If, from the level of the highest terrace, down to the present level of the river, all is alluvial, and formed of sand and gravel, it is then evident that the space as low as the river now runs must have been once occupied by water; at the same time, it is clear, that water must have stood or flowed as high at least as the uppermost surface of the meadow. It is impossible to reconcile these two facts, which are both undeniable, but by supposing a lake, or body of stagnant water, to have here occupied a great hollow, and that this hollow, in the course of ages, has been filled up by the gravel and alluvial earth brought down by the river, which is now cutting its channel through materials of its own depositing. It is said above, that the water must have run or stood, in former times, as low as the present bottom of the river; but there is often clear evidence that it has run or stood much lower, because the alluvial land reaches far below the present level of the river. In the course of the Tay, the Esks, the Annan, Nith, Clyde, and other rivers in Scotland, the phenomena just detailed are beautifully displayed.

3. *Lakes.*—In those lakes having an outlet, the water exercises a destroying effect on the interposing barrier, and next on the channel by which the water flows out, cutting it deeper and deeper until the lake is emptied. Hence the numerous basins observed in mountain countries, which still present, and well preserved, the fissure or channel through which the waters that formerly filled them made their escape. The well-known pass of the Elbe, leading from Bohemia, and that of L'Ecluse, are evidently the fissures or channels through which the waters of formerly existing lakes made them escape; and the *Irongate*, the famous pass through which the Danube flows from the Bannat into the plains of Wallachia, is of the same description. Thessaly appears formerly to have been in the state of a lake; but, as reported, a rent having taken place on one side of it, the water escaped with tremendous violence, devastated the lower country, and covered it with debris. The Waller Lake in the Tyrol rose so much, owing to the melting of the ice of the neighbouring glaciers, that it broke through its natural barrier; its water was precipitated with so much velocity and violence into the lower country, that whole valleys and plains were desolated and covered with rolled masses, and gravel and mud. A few years ago, a lake, of considerable extent, burst at the top of the valley of Bagne in Switzerland, devastated the whole valley, deposited in its course vast quantities of debris, and carried to considerable distances masses of granite, some of them more than 10,000 cubic feet in magnitude.

Many nearly inclosed valleys or basins are to be traced in the course of the rivers of this and other countries, and all of them have been formerly in the state of lakes, or are so at present. Thus the river district of the Rhine forms many basins, of considerable magnitude, of this description, in its course towards the ocean. The basin in which the Lake of Constance is situated is one of these; a second occurs in Baden, which extends from Upper Alsace to Handruck, and the vicinity of Mayence, where the Rhine forces its way through a narrow rocky passage. The river district of the Danube forms a basin in Bavaria, through which the river flows until near to Passau, when it escapes from it by a narrow pass which leads into a second basin, which comprehends the Austrian hereditary dominions. This basin extends to Presburg, when it terminates, and the Danube again forces its way through a rocky pass into Hungary: This kingdom is a great circular valley or basin, and the Danube, after traversing it, escapes by a rocky pass into the valley of the Bannat. This inclosed valley or basin is smaller than Hungary, and opens on its lower side, and affords a passage to the river through a rocky pass into the plains of Moldavia and Wallachia, which extend from thence to the Black Sea. We have a continuation of these valleys or basins, although still filled with water, in the Black Sea, the Sea of Marmora, and the Mediterranean Sea. The great lakes in North America are also a series of basins, traversed by the river St Lawrence. The Elbe, in its course from its origin in the Riesengebirge, downwards to Meissen, in Saxony, passes from one basin to another, and exhibits such phenomena, as show the great mechanical destroying effects of its waters, and that formerly these basins were in the state of lakes. The river Don, in Aberdeenshire, the Nith, in Dumfries-shire, the Beauly, in Ross-shire, afford other examples of rivers flowing through basins that appear formerly to have been filled with water.

Sometimes the waters of lakes, in place of attacking their barriers on the upper part, pierce them below, and this effect is assisted by the presence of a rent, or fissure, which affords an opportunity for the formation of an aperture. Some of the natural bridges described by authors appear to have originated in this way.

The rending of strata by earthquakes may have afforded openings to lakes, and these bursting out thus suddenly, may have given rise to devastating, and often extensive deluges.

The numerous loose blocks of mountain rocks met with in various countries, at a great distance from any fixed masses, or strata of the same description, appear to owe their present situations to great floods of water. Masses of this kind occur in Scotland, England, Wales, Ireland, Germany, in the great valley of the Po, and in the country between the Alps and the Jura range of mountains. The

Geognosy. magnitude of these masses, which are sometimes 50,000 cubit feet in content, have engaged the particular attention both of the scientific and the curious.

The most detailed accounts of these blocks are those given by Swiss observers, and to these we shall now principally confine our attention, as they are illustrative of their distribution in other countries.

Loose blocks of alpine rocks are found in the lower part of the alpine valleys, which terminate in the great principal valley that stretches between the Alps and the Jura, from the Lake of Geneva to the Lake Constance; and are also found almost every where in this great principal valley. They are sometimes met with 4000 feet above the level of the sea, on the side of the Jura facing the Alps, and also in considerable numbers in many of the valleys of the Jura itself. These blocks occur only on the surface, never in any solid rock, and no one ever met with them in the subjacent strata of sandstone, marl, or conglomerate of the hills and valleys interposed between the Alps and the Jura; but they are sometimes found deep in the soil, or imbedded, or surrounded with the debris formed by rivers.

The traveller is often surprised by the enormous magnitudes of these loose blocks, some of them being calculated to contain 50,000 cubic feet. The smaller masses are distinguished from those brought down by rivers by their position, that is, their occurring on heights and acclivities where no river could ever have run. They may also be confounded with blocks from decaying conglomerate, hence it is proper to be on our guard, not only to distinguish these blocks from those derived from conglomerate rocks, but also from the rolled masses belonging to river courses.

The height at which they are found does not appear to have any relation to their magnitude, for we often find very large blocks at considerable heights, and also in deep valleys; and we also meet with small masses as well in the bottoms of valleys, as high up on the mountains.

They occur sometimes in heaps or dispersed in single blocks; but these relations have no connection with their magnitude, because we often find large and small masses in the same heap, and single, large, and small blocks on mountain summits, and in the bottoms of valleys. The smaller blocks are more or less rounded, but seldom so much so as the boulders of rivers which have been exposed to long continued friction. The larger blocks are indeed angular, but not sharp-edged. But in examining this relation, we must carefully distinguish whether or not the angles or edges are original, or have been produced by subsequent natural or artificial causes. Very often masses of this description are blasted with gunpowder, either with the view of clearing the fields, or of obtaining stones for building; and these, if left on the ground, may lead into error.

These blocks vary in their nature, some being of the primitive class, while others belong to those of the transition and secondary classes. In general, they appertain to rock formations situated nearer to the central alpine chains than those of the places where they are found. Thus no rocks of the transition class occur in gneiss valleys; no alpine limestone in transition valleys; and in general, no where but in the Jura do blocks of Jura limestone make their appearance. Therefore all the loose blocks of rocks between the Jura and the Alps belong to the strata of the high chains of the Alps. Geognosy.

But these blocks have different characters in different districts. The loose blocks which occur in the river basin of the Rhone, and the Lake of Geneva, are quite different from those which lie strewed about in the river basin of the Rhine. These again are equally different from the loose blocks of the river basin of the Aare, as those of the Aare are from the blocks of the Lake of Zurich and the valley of Limmat; and these in their turn are equally well distinguished from the great accumulations in the valley of the Reuss. It rarely happens that intermixtures take place among these different accumulations of debris, and this is a circumstance which must be attended to in our investigation.

It results from an accurate comparison of these loose blocks with those mountain rocks which occur in extensive chains in the high Alps, that the loose blocks of every known river basin agree with the rocks which form the sides of the upper parts of those high alpine valleys which are in immediate connection with these great water basins. Thus the loose blocks of the water basin of the Rhine are similar to the rocks of Bundten. We find in the Lake of Zurich, and in the Limmat valley, the rocks of the Glarner land in loose blocks. The debris in the basin of the Reuss consists of rocks of the mountains from which the Reuss takes its rise. The loose blocks of the water basin of the Aare are similar to the mountain rocks of the high Alps of Bern; and the loose blocks, found in the course of the Rhone, occur in fixed rocks in the Vallais.

It thus appears that the loose blocks are by no means irregularly dispersed over the great valley between the Alps and the Jura, but are distributed in the direction of distinct water basins. It also appears, that the loose blocks are not irregularly distributed in these different basins; on the contrary, that in some parts of the basin they are accumulated in great numbers; in other places they are ra e, and in some situations none occur.

From the preceding observations, we may obtain some hints of importance in respect to the cause of this remarkable phenomenon. These loose blocks already occur in the alpine valleys, which open into the great valley, between the Alps and the Jura. They are found more abundantly in the wide parts of valleys immediately below the narrow or contracted passes, and few occur in the narrow steep and rocky parts of the valleys.

Loose blocks are found, at a greater or less height, in the smaller lateral valleys that open into the transverse alpine valleys, which terminate in the great valley between the Alps and the Jura. If these lateral valleys form passes (which lead over into other valleys by a lowering of the high mountain chain) which are not more than 4000 feet above the level of the sea, loose blocks occur, not only in these passes, but also more or less widely distributed in the opposite valleys. In the great principal valley which stretches between the Alps and the Jura, from

the Lake of Geneva to beyond the Lake Constance, we find these loose blocks dispersed over all the hills whose elevation is not more than 3000 feet above the level of the sea; but even here, the distribution of the blocks is not entirely irregular. The largest are found on such hills and acclivities as are opposite the mouths of the alpine valleys, in the great principal valley. The blocks are frequently found higher on such acclivities than on the sides of those valleys which may be considered as a continuation of the alpine valleys. The loose blocks are found every where on that acclivity of the Jura range which is opposite to the Alps, and they are found highest and largest in those places which are directly opposite the mouths of the alpine valleys. In such places, the blocks again attain an elevation of nearly 4000 feet above the level of the sea; whereas in the intermediate places, which are most remote from the places opposite the mouths of the alpine valleys, the blocks seldom reach at a height of 2000 feet above the level of the sea.

In those places where the Jura chain branches into the great valley between the Jura and the Alps, loose blocks are found in the valleys behind the projecting chains. The Jura range is sometimes intersected in places opposite to the Alps; and it is remarked, that loose blocks are met with in the valleys behind these intersected portions of the range; and that, when loose blocks occur in the Jura range at a distance from the Alps, it is only in such places as are directly opposite to the intersected portions of the chain opposite to the Alps.

The circumstance of the non-occurrence of these blocks in the sandstone, marl, and nagelfluh, which occupies the great valley between the Alps and the Jura, proves that that revolution of our globe by which these were dispersed, took place after the formation of these rocks, and may therefore have belonged to one of the latest changes which have contributed to the present form of the earth's surface.

When we compare the relations of the alluvium of the rivers in valleys with those of the loose blocks, their similarity must strike every one. Thus, rolled masses are seldom deposited in those places where a river forces its way through a narrow passage; but where an expansion takes place, owing to the distance of the banks increasing, the rolled masses are sometimes accumulated in whole banks. In the same manner loose blocks seldom occur in the narrow passages of the transverse valleys in the Alps; but as soon as widenings of the valleys take place below these narrowings, the blocks occur in abundance.

If, during a flood, a rupture takes place in the banks of a river, where it is contracted, a part of the stream will flow out by the lateral opening, and carry along with it rolled masses, even when the opening in the bank does not reach to the bottom of the bed of the river; for the mountain stream, loaded with boulders, carries them not merely in single masses along its bottom, but the flood water of the stream generally attacks large sand-banks, or older beds of rolled masses, and carries along with it, accompanied with a terrible noise, whole masses, forces them over the lower banks, or through the chasm in the bank, and often deposites them several feet high on an immediately succeeding widening of the river's course.

In the same manner, we observe loose blocks deposited on high situations in the lateral valleys of the great transverse valleys, and dispersed over the passes into the neighbouring valleys. The height of the lateral deposites of loose blocks, and their position in the passes and their passing into neighbouring valleys, are facts which assist us in judging of the extent of the power that may have acted during their transportation.

The striking agreement observable in the phenomena of the distribution of the loose blocks from the interior alpine valleys to the interior valleys of the Jura, with those in the rolled masses carried along by rivers, must lead every one, who reflects on this interesting phenomenon, to the hypothesis, that these blocks may have been deposited in their present situations by an immense flood which burst from the Alps. It is true, that this opinion is liable to many objections; but still it contains a more plausible explanation of the phenomenon than any other with which we are acquainted.

The loose blocks in the different river districts being in general separated from each other, or if any intermixture takes place of the rolled masses of one valley with that of another, it being only on their edges, it is highly probable that the floods which burst from these valleys, and carried along with them the masses of rocks, may have been simultaneous, by which the flood of the one basin would bound and limit that of the other, and thus prevent the water flood of one basin flowing into the neighbouring ones.

The contemporaneous occurrence of these different floods from the alpine valleys, can alone in this hypothesis explain why this aqueous flood was so generally and so highly accumulated in the great valley between the Alps and the Jura, as to reach the height of most of the sandstone mountains, and to a great elevation on the Jura, where many blocks are found deposited. But if the contemporaneous occurrence of these floods is proved by the facts, already enumerated, to what cause are we to refer this simultaneous bursting of floods of water from so many alpine valleys?

We observe, on the north-western side of the chain of the Alps, numerous openings, which, by their structure, seem to point out the action of violent floods. Let us suppose the numerous valleys, in the districts already described, closed at their present entrances, or openings, as would seem from their structure to have been formerly the case; the consequence of this arrangement would be the filling of the alpine valleys with water to the height of the lowest passes among the mountains, and thus an enormous accumulation of water would take place. This great body of water, if let loose at once, by the bursting of the lower extremities of the valleys, would form a flood which would sweep across the sandstone mountains between the Alps and the Jura range, and even ascend high on the Jura itself. This flood of water, moving probably at the rate of 200 feet in a second, and loaded with debris of rocks, would carry masses, even those having a magnitude of 50,000 cubical feet, some thousand feet high on

the Jura range.* But to what cause are we to attribute this effect? This is a question we cannot answer.

4. *Ocean.*—The waters of the ocean exercise a powerful destroying effect on the borders of the basins in which they are contained. If the coasts are bold and rugged, they are violently assaulted by the waves of the ocean; the crags and cliffs split and tumble down in frightful and irregular succession, and if the sea is not too deep in proportion to the mass of land, the debris accumulates at their feet, and in a longer or shorter period of time, a bank of these fragments rises at the foot of the cliff, reaches the surface of the water, even rises above it, and thus a barrier is formed which protects the cliffs from the future assaults of the ocean. If the coasts surround an island whose bulk is inconsiderable in comparison of the depth of the surrounding sea, the whole in the course of time is broken down and buried under the waves of the ocean, and in the place of an island there is formed a rocky shoal.

The perforated rock, the Dorcholm, on the west coast of Shetland; the perforated rocks described by Captain Cook, near New Zealand; the stalks, holms, and skerries, on the coasts of Shetland, Scotland, Norway, &c. are effects of the destroying power of the waves.

In those rocky coasts where the strata are of unequal hardness, the softer portions, and also part of the surrounding harder mass, are removed by the action of the waves, and thus form the caves so frequently met with on sea coasts. These caves often occur at a considerable distance from the present margin of the basin of the ocean, owing to the interposition of a greater or less extent of newly formed alluvial land. Caves also occur situated in sea cliffs at a considerable height above the level of the sea. Some of these have been formed in the following manner. The cliffs, when their bases were washed by the sea, appear to have been perforated to a considerable depth and height by the impulse of the waves; and large masses of the softer interior strata washed out, and thus internal caves have been formed, situated often several fathoms above the level of the sea. The destroying effects of the sea continuing, the cliffs concealing these internal caves yield, the internal caves become open caves, and appear at a considerable height above the level of the sea. This mode of formation is well seen in the sandstone cliffs on the east coast of Scotland.

The waters of the ocean often occasion dreadful ravages in the low countries exposed to its fury. Holland furnishes many striking examples of its devastating power. In the year 1225, the waters of the ocean, agitated by a violent tempest, inundated the country; the Rhine, swollen, at the same time, by extraordinary rains, and retained at a great height, partly by the waters of the ocean, partly by the winds blowing in a contrary direction to its course, spread over the neighbouring country; but the tempest having suddenly subsided, the highly elevated waters retired with such velocity and force as to carry with them a considerable portion of the soil, and left in its place the sea now named the *Zuyder Zee*. In the year 1421, a great inundation submerged the southern part of the province of Holland, drowned 60,000 persons, and on retiring it formed, near to Dortrecht, the arm of the sea named the *Bies-Boos*. Florus speaks of a rising of the waters of the sea in the year of Rome 644, which forced the Teutonians, Cimbrians, and Tigurians, back from the countries they inhabited. This was occasioned by a violent north wind, which raised the water of the ocean along the coasts of the countries occupied by these nations.

Such are the general destroying effects of the water of the ocean on the margin of its basin. Let us next inquire what are the changes which it produces on the submarine land.

The motions of the sea, even during a storm, do not reach to a great depth, seldom many fathoms, and hence its destroying effects cannot, in such cases, reach far, although they are sometimes so considerable as to break rocks in pieces, and throw them upon the coasts in masses of various sizes and forms.† But the effects appear to be more considerable in the course of those great currents that traverse the ocean; such as the equinoctial current and the Gulf Stream. The great depth of water in the course of the Gulf Stream would seem to prove that the corroding influence of the water

* The velocity of the burst of water from the Glacier Lake, at the top of the valley of Bagne, and its density owing to the great intermixture of debris, is in harmony with the fact, that it moved along blocks of granite some thousand cubic feet in magnitude, and deposited some of them on the sides of the valleys at a *considerable height above their bottoms.*

† "In disposing of the waste of the surrounding land beyond the accumulation of the sunken banks of the German Ocean, we are not left at any loss for a disturbing cause, as this is provided by the tides and currents of the sea; and with regard to their action, we have many proofs, even at very considerable depths, by the breaking up of the wrecks of ships, the occasional drift of sea-weed, and also drift timber, into regions far distant from those in which they are spontaneously produced. The dispersion of fishes, evinced by their disappearance from the fishing grounds in stormy weather, tends to show the disturbance of the waters of the ocean to the depth of 30 or 40 fathoms. This observation I have frequently had an opportunity of making near to the entrance of the Frith of Forth. Numerous proofs of the sea being disturbed to a considerable depth have also occurred since the erection of the Bell Rock Light-house, situate upon a sunken rock in the sea, twelve miles off Arbroath in Forfarshire. Some *drift-stones* of large dimensions, measuring upwards of thirty cubic feet, or more than two tons weight, have, during storms, been often thrown upon the rock from the deep water. These large boulder-stones are so familiar to the light-keepers at this station, as to be by them termed *travellers.*"—Stevenson in *Memoirs of the Wernerian Nat. Hist. Society*, Vol. III.

Geognosy.

had been sufficient to scoop out a channel or hollow in the bottom of the sea in the line of direction of the current. When the currents of the ocean are assisted by the waves and the winds, destroying effects of great magnitude are produced. It is probably in this way that some straits have been formed. Buffon remarks on this subject, that most of those in the equatorial seas are directed from east to west, like the great equinoctial current, and that it is probable this current may have formed many of them.

5. *Action of Water by its own Weight.*—Water, by its own weight, contributes very much to the degradation of the surface of the globe. Sometimes large masses of rock, particularly those of a soft nature, imbibe much water, by which their weight is increased, and thus occasions breaking, and rending, and slipping of masses often of enormous magnitude. These effects, it is remarked by Bergman, take place most frequently, and to greater extent, during wet than in dry seasons. In proof of this, it may be mentioned, that in the year 1805, at the close of a wet summer, and during a very rainy day, a vast mass loosened from the Rigiberg in Switzerland. This hill, situated about 1150 metres above the valley in which it occurs, is formed of sandstone, and of a conglomerated rock named Nagelfluh, having a marly basis. On the 2d of September there loosened from it an enormous mass, 4000 metres long, 400 metres broad, and 30 metres thick; it buried in its ruins several villages, destroyed 500 persons, and raised in the bottom of the valley hills nearly 200 feet in height. In the year 1618, the once considerable town of Plurs, in Graubunden, with the neighbouring village of Schelano, were overwhelmed by a vast mass of rock, which had imbibed much water, and separated from the south side of the mountain of Corto. In the year 1714, the west side of the Diableret, in the Vallais, separated, and in its course downwards covered the neighbouring country with its ruins for two miles in length and breadth, and the immense blocks of stones and heaps of *debris* interrupted the course of the rivers; and lakes were thus formed. Many instances are on record of the lakes formed in this way, and of great extent, afterwards bursting, and devastating immense tracks of country.

6. *Effects of the Freezing of Water.*—In the temperate and colder regions of the earth the expansive power of frost in breaking up rocks is often extremely striking. In the history of Norway, and in the descriptions of northern, particularly of arctic countries, we meet with many accounts of the noises and rendings of the rocks by frost. Terrible disasters take place in alpine countries by the bursting and fall of vast masses of rock, split by the freezing of the water in their rents and fissures. Saussure, during the few days of July he passed on the Col de Geant, says, not an hour passed in which he did not hear the noise of rocks splitting and falling down the acclivities by the freezing of the water in their fissures.

7. *Destroying Effects of Ice and Snow.*—Water in the form of ice occasions considerable changes on the surface of the earth. Thus, when floated along in great masses by rivers, it breaks up their banks, and thus allows them to devastate the lower country; and often the masses are so large, and the power of the river so great, that enormous fragments of the solid strata are thereby torn of and carried to a distance. When sea ice is forced against the cliffs and precipices of the coast, the breaking and destruction it occasions are sometimes almost incredible. For the breaking up and moving of large masses of rock, one of the most powerful engines employed by nature are the glaciers, those great accumulations of congealed water and snow which form the lower boundary of the snow line in Switzerland and other regions of the globe. These great masses, says Professor Playfair, are in perpetual motion, undermined by the influx of heat from the earth, and impelled down the acclivities on which they rest by their own enormous weight, together with that of the innumerable fragments of rock with which they are loaded. These fragments they gradually transport to their utmost boundaries, where a formidable wall ascertains their magnitude, and attests the force of the great engine by which it was erected. The immense quantity and size of the rocks thus transported have been remarked with astonishment by every observer, and explain sufficiently how fragments of rock may be put in motion, even where there is but little declivity, and where the actual surface of the ground is considerably uneven. The fall of consolidated snow often also occasions considerable changes. In mountainous countries vast masses separate, are precipitated with great velocity, accompanied with terrible noises, carrying along with them rocks of vast size, and sometimes burying villages under them.

II.—*Chemical Destroying Effects of Water.*

Rain water enters the fissures of the earth in a comparatively pure state, but often issues forth again more or less impregnated with various mineral substances which it has dissolved or abraded from the strata through which it has passed. Thus, when it passes through beds of rock salt, or of rocks richly impregnated with salt, salt springs are formed, and in this way enormous quantities of salt are annually brought from the interior of the earth. The quantity of salt dissolved is sometimes so great, that internal caves or hollows are formed, whose roofs sometimes fall in, and cause great irregularities on the surface of the ground. Spring water, in passing through beds and masses of gypsum, dissolves a portion of it, and in this way sometimes occasions considerable changes in the interior of the earth. Carbonat of lime also yields to the solvent powers of water, particularly when assisted by carbonic acid. Many of the excavations in limestone hills are partly owing to this destroying effect of water. Other chemical destroying effects of a similar nature might be mentioned, but those we have just stated are the most considerable, and therefore no further detail is here necessary.

Destroying Effects of the Atmosphere.

The combined influence of the air and moisture of the atmosphere effects great changes on the rocks at the surface of the earth. It either simply disintegrates the rock, or not only breaks it down, but also occasions a change in its chemical constitution,

Sandstone, and other rocks of the same general description, often yield very readily to the influence of the weather; their basis or ground is washed away, and the quartzy and other particles remain in the form of sand and gravel. When trap veins intersect strata, it not unoften happens that their outgoing or crop appears rising several feet or yards above the neighbouring strata, and crossing the country like great walls; hence, in Scotland, they are named *dikes*. In other cases, the outgoing of beds of rocks, as of trap, appear rising to a considerable height above the general surface. In these cases, the softer bounding strata have yielded to the gnawing influence of the weather, while the harder trap, and other rocks, more obdurate, and less liable to decomposition, has resisted longer its destroying powers. Numerous examples of these effects occur in Scotland, as in Arran, Jura, Mull, west coast of Argyle, Eigg, Rume, Skye, &c. Veins of quartz also traversing granite, gneiss, mica-slate, and clay-slate, sometimes rise above the surface, and appear as dikes.

The various mountain summits owe much of their form to the destroying influence of the atmosphere. The needles, and peaks, and pyramidal forms of Alpine regions, and the tabular and round-backed forms of lower mountains, although not entirely the effects of decomposition, as some maintain, certainly have had their original forms thereby considerably changed.

Some kinds of caves, as those in certain sandstones and limestones, owe their origin to the destroying powers of the atmosphere.

The various changes in the form of rocks, by which they assume columnar, globular, tabular, indeterminate angular forms, and fall down into scales, crusts, layers, indeterminate angular grains, and sands, are, to a certain extent, effects of the destroying powers of the atmosphere.

To the destroying influence of the atmosphere valleys owe much of their present aspect. Their sides and summits, everywhere exposed to its action, become covered with debris; and, in this way, valleys sustain much greater changes than those which are produced on their bottom by the passage of the river, and on its sides by the rushing of its torrents.

But, besides these mechanical effects, many chemical destroying changes take place through the agency of the atmosphere. Felspar is often very liable to decomposition; it breaks down, and, finally, forms a kind of porcelain clay. During its decomposition, the alkali it contains is abstracted, and carried away by the atmospheric water. Other minerals are broken down and changed, by their absorbing some of the constituent parts of the atmosphere; thus, iron-pyrites, or sulphuret of iron, an insoluble substance, is in this way converted into sulphat of iron, a soluble salt; other minerals, as those abounding in iron, have their metallic ingredient changed from an oxide into a hydrate; and iron-pyrites, when contained in coal, sometimes, by its decomposition, gives it a burnt aspect.

Forming Effects of Water.

Mechanical Forming Effects.

1. *Rain Water.*—The forming effects of rain water, in its course over the surface of the earth, are confined to the removal of loose earthy matters, and their deposition at the foot of the inclined planes down which it flows. When, however, the rains are violent and long continued, they carry along with them coarse gravel, and even rolled masses or boulders, of considerable magnitude. These effects taking place generally over the whole face of the earth, occasion considerable changes on its surface, by these removals and depositions of the disintegrated and broken rocky matter.

2. *Springs.*—Some springs deposite considerable quantities of muddy matter, and thus form flat, and sometimes even hilly tracks of country.

3. *Lakes.*—These give rise to great depositions of alluvial matter, and when they burst their barrier, at different times, leave on their sides series of terraces, or platforms, of which we have a fine example in the *parallel roads* of Glen Roy.

4. *Rivers.*—Rivers, in their ordinary state, when confined to their beds, do not give rise to any new formations; only it has been remarked, that, towards their mouth, they have a tendency to raise their beds. Very different is the case during floods, when they overflow their banks, and cover the neighbouring country with their waters. Then they roll along with them quantities of boulders, gravel, slime, and mud, which have been taken up from the soil over which they have passed, and these are gradually deposited over the surface of the country. The boulders are first deposited, next the gravel, and, lastly, the sand and mud. These sediments, accumulated during a long series of years, give rise to very considerable formations. The country along the banks of the Mississippi affords striking examples of the varieties and great extent of this mechanical forming effect of water. The vast plains on the sides of the Amazon River owe their formation in part to this effect of river water. Every hundred years, as we are informed by Girard, the Nile deposites on the soil of Lower Egypt a sediment of nearly five inches in thickness; and the flat lands there are composed of similar alluvial matters, and to an unknown depth. The water of rivers flowing over the same districts at different times, and not always conveying the same materials, have thus accumulated different substances above each other; and hence the alternations of beds of boulders, gravel, sand and clay, met with in countries formed by the alluvium of rivers. The soil of Egypt presents beds and veins of sand in the midst of the mud deposited by the Nile.

The beautiful holm, or haugh-lands, on the sides of our rivers, and which are often the richest parts of the country, have been formed by this mechanical agency of water. But these formations, although very considerable, are not the only ones effected by rivers. Besides the great deposites laid over the country they traverse, they carry along with them, to the shores of the ocean, and to the entrances of lakes, much disintegrated matter.

When any considerable river or stream enters a lake, a flat meadow track is formed, which continues to increase from year to year. The soil of this meadow is terminated by a marsh, which marsh is ac-

Geognosy.

quiring solidity, and is soon to be converted into a meadow, as the meadow will be into an arable field. All the while the sediment of the river makes its way hourly into the lake, forming a mound or bank under the surface of the water, with a pretty rapid slope towards the lake. This mound increases by the addition of new earth, sand, and gravel, poured in over the slope; and thus the process of filling up gradually advances. These phenomena are to be seen in all the lakes that receive rivers in this and other countries. This forming effect of water is very striking in the larger lakes. Thus, where the Rhone enters the Lake of Geneva, the beach has been observed to receive an annual increase, and the Portus Valesiæ, now Port Valais, which is at present half a league from the lake, was formerly close upon its banks. The great North American lakes are undergoing similar changes. In the course of ages lakes are filled up, when the country thus formed presents, in place of a lake, a plain traversed by the river. This change is effected partly by the filling up of the lake by the debris carried into it by the river, and partly by the draining off of the water by the deepening of the outlet. This latter is an operation which is generally visible. The stream, as it precipitates itself over the rocks, hurries along with it, not only sand and gravel, but also large blocks of stone, which grind and wear down the rocks, and materially assist the water in its deepening operation. Rivers, as already mentioned, carry to the sea-shore a portion of the loose matter removed from the surface of the earth by their destroying power. When they reach the sea, their velocity gradually diminishes, and is soon annihilated. As it diminishes, the coarse sand is deposited on the edges of the stream where the motion is least; and the finer particles are carried onwards to a distance from the coast. The alluvia formed in this manner at the mouths of rivers, and on their sides, by the current, are often very considerable. The Thames, Elbe, Rhine, and other rivers, afford striking examples of these formations. Prony informs us, that the River Po has so greatly raised the level of its bottom, since it was shut in by dikes, that its present surface is higher than the roofs of the houses of Ferrara. At the same time, the alluvial additions produced by that river have advanced so rapidly into the sea, that, by comparing old charts with the present state, the coast appears to have gained no less than 14,000 yards since the year 1604, giving an average of 180 to 200 feet yearly, and in some places the average amounts to 200 feet. The Nile, the Orinoco, and other great rivers in America, exhibit similar phenomena. At the mouth of the Mississippi large alluvial islands are formed, and, within the period of 100 years, the alluvial lands formed by it have extended several leagues into the sea.

The debris brought down by rivers when deposited in nearly inclosed seas, renders them shallower, and their borders are increased in extent. The Baltic has been computed to decrease in depth at the rate of forty inches in a hundred years. In proof of the increase of the shores of the Baltic, the following facts may be adduced. The Bay of Fulbacka, which was navigated by boats within the memory of man, is now filled up, and covered with grass. Several harbours in Lapland, that formerly admitted vessels, are now 3000 or 4000 paces from the sea; and at Helsingor, there are iron-works at places which were covered by the sea about eighty years ago. The whole of the ancient kingdom of Prussia appears to have been formed by alluvial depositions; it is said that the sea reached as far as Culm within the period of credible history. Dantzic, several hundred years ago, was close to the sea-shore. The Yellow Sea, which is a large gulf contained between the coast of China and the Peninsula of Corea, and which has somewhat of the character of such seas as the Baltic, receives so much mud from the great rivers that run into it, that it takes it colour, as well as its name, from that circumstance, and computations have been made of the time that it will require to fill up this gulf, and to withdraw it entirely from the dominion of the ocean; and these, although not very satisfactory, are considered as showing that it will be filled up in 240 ages.

The alluvial matter brought down by rivers, not only forms great tracks of land at their mouths, but also by the agency of currents, assisted by the waves of the ocean, gives rise to extensive tracks of low and flat land, which extend along the coast.

It is well known that the Mediterranean is at present one league from Aigues-Morte, in Provence, where St Louis embarked in 1269. Ravenna, which, in the time of Augustus, projected into the sea, is now nearly three miles from it; and the site of Venice and other similar situations will, in the course of time, experience the same fate. Spena had been originally built by the Greeks on the sea-coast; but in the time of Strabo, the sea was removed to the distance of ninety stadia. Adria, which gave name to the Adriatic, was, somewhat more than twenty centuries ago, the chief port of that sea, from which it is now at the distance of six leagues. The formation and increase of new grounds by alluvial depositions proceeds with equal rapidity along the coasts of the North Sea as on those of the Adriatic. These additions can easily be traced in Friesland and Groningen, where the epoch of the first dikes is well known to have been in the year 1570. An hundred years afterwards, the alluvial depositions had added in some places three-quarters of a league of new land on the outside of the dikes. The same phenomenon is distinctly observable all along the coasts of East Friesland, and the countries of Bremen and Holstein, as the period at which the new grounds were inclosed by the dikes for the first time is perfectly well known, and the extent that has been gained since it has been measured.

When the sea-coast is low, and the bottom consists of sand, the waves push this sand towards the shore, where, at every reflux of the tide, it becomes partially dried, and the winds, which often blow from the sea, drift up some portions of it upon the beach. By this forming effect of the ocean, *downs*, or ranges of low sand-hills, are formed along the coast. These accumulations of sand, if not fixed either by natural or artificial means, advance towards the interior of the country. In their progress inland, they push

before them great pools of water, formed by the rain which falls on the neighbouring grounds, and which has no means of running off, in consequence of the obstructions interposed by the downs. In several they proceed with a frightful rapidity, overwhelming forests, houses, and cultivated fields in their progress. M. Bremontier, who made extensive works with a view of stopping the progress of the downs, in the south of France, estimated their progress there at sixty feet yearly, and in some places at seventy-two feet.

Sand-banks.—These also are to be considered as forming effects of water, and the general opinion is, that they are produced sometimes by the meeting of currents, and in other cases by depositions from currents interrupted by land, whether submarine or dry land. Thus the formation of the banks on the coast of Holland, and even of the Dogger Bank itself, is ascribed to the meeting of tides, by which a state of tranquillity is produced in the waters, and of consequence a more copious deposition of their sand and mud. The great bank of Newfoundland is conjectured to be a deposition from the waters of the Gulf Stream.

Chemical Forming Effects of Water.

Springs.—Certain spring waters, after dissolving, by means of the superabundant carbonic acid with which they are impregnated, calcareous earth abraded from limestone rocks, or rocks containing calcareous matter, allow the lime to crystallize, in consequence of the escape of the acid, and in this way form depositions of calc-sinter, or calcareous alabaster, on the roofs, sides, and floors of caves, or fill up fissures in rocks, and form veins, or when flowing over the surface of rocks, incrust them with calcareous sinter, or calcareous tuffa. The water of such springs, when collected in hollows so as to form lakes, often deposites vast quantities of calcareous tuffas, and hence these lakes, when dried up, present very extensive formations of these calcareous minerals. The *travertine* employed for building at Rome is a calcareous deposition from the waters of springs; and the town of Guancavelica, in South America, is built of a compact calcareous tuffa from the calcareous springs in the neighbourhood. The calcareous tuffa is most generally formed in open exposed places, but calcareous sinter chiefly in inclosed spaces, such as caves, &c. The peastone of mineralogists is formed from the waters of hot springs, as those of Carlsbad in Bohemia. The hot springs of Iceland, St Michael's, &c. deposite vast quantities of siliceous sinter, and this siliceous compound, although generally pure, is not always so, being occasionally intermixed with other minerals, and thus gives rise to particular mineral substances.

3. *Lakes.*—We have already noticed the calcareous depositions from the waters of some lakes, we shall now give an account of depositions of other kinds of minerals. The bog iron-ore of mineralogists is often found in such situations as to show it had been formed by deposition from the water of lakes; and in some countries it is collected from the sides and bottoms of lakes once in a certain number of years, thus showing that it is still forming in such situations. In salt lakes considerable depositions of salt take place, and when such collections of water dry up, or are drained off, the sides and bottom of the cavities are found incrusted with salt, which is sometimes disposed in beds alternating with layers of clay.

4. *Marine Incrustations.*—Collections of sea shells are sometimes found agglutinated, and form banks or beds of considerable extent. But Cuvier remarks, we have no evidence that the sea has now the power of agglutinating these shells by such a compact paste, or indurated cement, as that found in marbles, or even in the coarse limestone strata in which shells are found enveloped. Still less do we now find the sea making any depositions at all of the more solid and siliceous strata which have preceded the formation of the strata containing shells. A compact calcareous alluvial rock is found in considerable abundance on the coasts of the West India islands, by the conglutination of fragments of shells and corals. The human skeleton from Guadaloupe, in the British Museum, is imbedded in rock of this description.

General Account of the different Classes of Rocks.

Before the time of Lehman, the formations of which the crust of the earth is composed, were believed to be destitute of all regularity in distribution and in individual characters. That intelligent miner, however, was early convinced of the existence of a certain degree of order in their arrangement, and at length, in his well known work, first stated their division into *Primitive* and *Secondary*; under the first including those destitute of fossil organic remains, and which he considered as disposed in highly inclined strata, and as forming the most lofty, rugged, and hardest parts of the surface and interior of the earth; while under the other he arranged all those containing petrifactions, or fossil organic remains, or which were associated with others containing such remains, and which, he says, are disposed in strata more horizontal, and form the lower and softer portions of the surface and interior of the earth. As geognosy advanced, new facts were added to those already known, and new arrangements and distributions of the formations were discovered. Werner first pointed out another class of rocks, which he named *Transition*, as they exhibit such characters as show the transition from those of the primitive to those of the secondary classes. These are interposed between the primitive and secondary classes, and are the first or earliest rocks of which the crust of the earth is composed, that afford fossil organic remains. The same illustrious naturalist examined with great care the various characters of those loosely cohering rocks of clay, marl, loam, &c. which rest on the more solid and older rocks of the secondary, transition, and primitive classes, and which form a fourth class, under the title *Alluvial*. The various mineral masses formed by the agency of volcanoes were but slightly noticed by Lehman, but claimed much of the attention of Werner, who formed them into a fifth class, under the title of *Volcanic*.

These different classes of rocks are met with in most extensive tracts of country, and every where

Geognosy.

exhibit the same general relations. Thus the primitive rocks of Scotland, on a general view, do not differ from those of New Holland, and the rocks of the secondary class, although at first sight presenting much of a local character, are the same in all parts of the world where they have been hitherto met with.

I. *Primitive Rocks.*

The rocks of this class lie under those of the succeeding classes, and frequently, owing to the inequalities of their original surface, rise through them, and often to a great height, in the form of mountains and mountain chains. Countries composed of primitive rocks are in general more rugged and lofty than those of the other classes; further, their cliffs are more extensive, their valleys narrower and deeper, and more uneven than those in secondary countries. The strata of primitive mountains are very frequently highly inclined, a circumstance which contributes, in an especial manner, to the increase of the ruggedness and inequalities of the surface of primitive regions. The primitive strata in many countries maintain a wonderful uniformity of direction; thus, in Scotland, the general direction of the strata of the primitive mountains is from N. E. to S. W., and the same is the case nearly in the vast alpine regions of Norway, and in many of the lofty and widely extended primitive lands of other parts in Europe. In Scotland the direction is so invariable, not only in the primitive but also in the transition strata, that travellers may use it in place of a compass in guiding themselves through the mountain wilds of our Highland regions. The rocks of which primitive mountains and plains are composed are, throughout, of a crystalline nature, and present such characters as intimate their formation from a state of solution. These characters are the intermixture of the concretions of which these are composed at their line of junction, their mutual penetration of each other, their considerable lustre, pure colours, and considerable translucency. Thus, in granite, the concretions of felspar, quartz, and mica, are joined together without any basis or ground, and at their line of junction are either simply very closely attached together, or are intermixed, and frequently branches of the one concretion shoot into the other, thus occasioning a mutual interlacement, as is observed in bodies that have been formed simultaneously, and from a state of solution. These characters show that the concretions of granite, and the same applies to the concretions in limestone, gneiss, mica-slate, and other rocks of the primitive class, are of a crystalline nature, and have been formed at the same time.

The strata themselves are so arranged in mountains, that is, one set of strata including another, as to render it probable, that the seams of the strata are not a mechanical effect, but have been produced in the same manner as the seams of distinct concretions, or the surfaces of crystals. These strata, collected in groups, give rise to *formations*, such as gneiss or mica-slate; and in those cases where the rock is not distinctly stratified, it exhibits such characters as point it out in an unity or formation in the grand series, of which the crust of the earth is composed. The rock formations in primitive countries, although well marked and distinguished by their general and particular characters, are not in any case isolated or unrelated to each other; on the contrary, we find, as they approach and join each other, gradual transitions of the one into the other, or intermixtures and interlacings at their great lines of junction. No true primitive rock appears foreign to the others, or exhibiting such characters as intimate a different mode of formation. Thus granite, which some consider a kind of lava, and therefore formed in different manner from gneiss or mica-slate, passes into and is intermixed with the surrounding rocks, and therefore has been formed in the same manner.

Primitive rocks are distinguished from those of the succeeding classes, by the absence of all fossil organic remains. This important fact allows us to infer, that organic beings had not been called into existence during the formation of primitive rocks, so that there was a time, in the history of the formation of our planet, when plants and animals did not exist. Although no traces of organic life occur in primitive rocks, yet they afford beds of a kind of coal (glance coal), almost entirely composed of carbon, a substance which many consider as peculiar to the organic kingdom, and which, they maintain, when found in the mineral kingdom, is to be traced to previously existing organic beings. This opinion is disproved, not only by the facts already mentioned, but also by the occurrence of carbon in hornblende, slate, and other minerals of the primitive class. Here then we have the formation of carbon, independent of the agency of animals and vegetables.

Limestone has been by many considered as entirely the result of animal action, and the various formations of that rock, whether in primitive or secondary mountains, are viewed as accumulations of altered shells or corals. But neither shells nor corals occur in primitive mountains, although they often contain extensive beds of limestone; and further, lime enters as a constituent part into most of the simple minerals of which primitive rocks are composed, facts which show that lime, like carbon, is an original substance in primitive mountains, and therefore has been formed at times independent of animals.

The two most abundant alkalies, viz. natron and potash, occur in primitive mountains, but of these, the potash is by far the most frequent and abundant Before the discovery of potash in lepidolite, a primitive mineral, by Klaproth, this alkali was considered as entirely a production of the vegetable kingdom; but no vegetable remains occur in primitive rocks; and, therefore, in this case, the potash has been formed by some other agency than that of vegetation.

Phosphat of lime, which forms so important a constituent part of the higher animals, was long maintained to be exclusively a production of the animal kingdom; its after discovery in some vegetables, demonstrated that it also was occasionally produced in some tribes of plants; but still it was believed to be in every case either of animal or vegetable origin. But geologists, by the discovery of apatite, or phosphat of lime, in primitive mountains, have proved its existence in nature, independent of the agency of the organic kingdom.

Primitive rocks abound very much in metallife-

rous minerals, and hitherto no metal has been met with which does not occur exclusively, or occasionally, in this class of rocks. Tin, wolfram, and molybdena, occur more frequently in these rocks than in other situations. Gold, silver, lead, copper, iron, cobalt, zinc, manganese, arsenic, and mercury, occur either disseminated, in beds, veins, or imbedded, in various rocks of this class, and many primitive districts are particularly characterized by the metalliferous repositories they contain; thus, the primitive district of Strontian is characterized by its particular venigenous formation of galena, or lead-glance; the primitive country of Königsberg, in Norway, by its group of veins of silver-ore; and the primitive gneiss rocks of Arendal and Lapland, by their beds of magnetic iron-ore.

The most beautiful of all the productions of the mineral kingdom, the gems, occur in great variety in primitive rocks. Nothing can be more beautiful than the drusy cavities met with in primitive mountains, whose walls are lined with pure and variously coloured and crystallized topaz, beryl, and rock crystal; and the gneiss, granite, and mica-slate, with their imbedded grains and crystals of sapphire, crysoberyl, and garnet; and the veins in granite, clay-slate, and other primitive rocks, with their emeralds, axinite, and spinel ruby, afford to the mineralogist highly interesting combinations.

But the most precious of all the gems, the diamond, is wanting in primitive regions. Judging of it from its splendid lustre, pure and beautiful colours, high degree of translucency, and great hardness, we would have expected it to occur in the cavities or veins of primitive rocks. But it is far otherwise, for it appears only in alluvial formations of gravel, clay, and sand, of new formation, removed at an immense distance from those that form the grand basis of the crust of the globe; thus intimating its recent, and probably vegetable origin.

From what has been already said, it is evident that the study of these rocks must be highly interesting, in an economical point of view. Many of the richest and most important mines in the world are situated in primitive rocks; statuary marble, and the various granites, porphyries, and serpentines, so much valued in the arts; and the gems, so distinguished by their beauty of lustre, colour, and great hardness, are principally contained in formations of the primitive series.

Different Primitive Rocks.

The following are the rocks that occur in primitive mountains, viz. granite, porphyry, trap, serpentine, limestone, gneiss, mica-slate, clay-slate, and quartz rock.

These rocks are very simple in their nature, being generally composed of not more than five minerals, viz. quartz, felspar, mica, hornblende, and limestone. Some rocks are composed of but one of these simple minerals, as quartz rock; others of two, such as mica-slate, which is a compound of mica and quartz; and others, as granite, consist of three of them, viz. quartz, felspar, and mica. In determining the species of primitive rocks, we must have an accurate acquaintance with the five simple minerals already enumerated, and with the aspects they assume when forming these aggregate mountain rocks. This being the case, nothing more is necessary than to refer the reader to the characters of these simple minerals given in the mineralogy of this article, and now to give short characters of the rocks themselves.

1. *Granite* is a granular compound of felspar, quartz, and mica; *syenite* is a variety of granite, containing, besides the ingredients already enumerated, also hornblende.

2. *Porphyry* is an aggregate rock, having a basis or ground containing imbedded grains and crystals of felspar, and sometimes of quartz and hornblende.

3. *Trap.*—All the rocks of the primitive class in which hornblende is the predominating ingredient are named trap. On exposure to the air they assume the form of steps of a stair, hence the name *trap.* When the hornblende is associated with felspar, it forms *greenstone;* if unmixed, *hornblende rock;* and if slaty, *hornblende slate.*

4. *Serpentine* is a dark green rock, with a splintery fracture, and glimmering or dull lustre, translucent on the edges, and so soft as to yield readily to the knife. It is conjectured to be a compound of felspar, and of a mineral of the nature of hornblende, named diallage.

5. *Limestone.*—This rock has generally a white or grey colour, is composed of shining granular concretions, and is more or less translucent. It frequently contains scales of mica and grains of quartz.

6. *Gneiss* is a granular slaty compound of felspar, quartz, and mica.

7. *Mica-slate* is a slaty compound of mica and quartz.

8. *Clay-slate* is a slaty rock, generally composed of extremely minute scales of mica. It is the roof slate so well known in the arts.

9. *Quartz-rock.*—This rock is almost entirely composed of quartz, either in granular concretions, or in the compact state; and grains of felspar and scales of mica are frequently contained in it.

II.—*Transition Rocks.*

Transition rocks succeed to the primitive, and are followed by those of the secondary class. They generally, in this country, occupy a higher level than the secondary, but a lower one than the primitive formations. Their mountains, mountain-ranges, mountain-groups, and cliffs, are more rugged than those of the secondary class, but are less rugged and softer in their outlines than the primitive rocks. Their valleys, too, are wider, and their sides less rugged and abrupt, than in those of primitive mountain-groups.

Most of the rocks are distinctly stratified, and the strata are frequently vertical, and, like those of the primitive class, exhibit the same general direction throughout great tracks of country. Thus the strata in the great high land which ranges from St Abb's Head to the Irish Sea, and which is almost entirely composed of transition rocks, range everywhere nearly from N. E. to S. W.

Although most of the transition rocks appear to have been formed from a state of solution, and there-

fore possess the crystalline character, yet their crystallization appears to have been less perfect than in the primitive rocks, because the parts of which they are composed have a lower degree of lustre, inferior hardness, less translucency, and colours of less purity, than primitive rocks. In short, on a general view, we would say, these rocks have more of the earthy aspect, and of the fragmented character, thus intimating a lower degree of crystallization, than is observable in the primitive class. But transition rocks are further distinguished from those of the primitive class, by the very important circumstance of their containing fossil organic remains. These petrifactions are of corals and shells, animal productions low in the zoological scale; and of vegetable remains that appear to belong to plants of the most simple construction, such as those of the class cryptogamia, and therefore at the bottom of the botanical scale. Hence it follows, that animals and vegetables of the more simple construction were those first called into existence, and that their creation did not take place until the period of the formation of transition rocks. Corals of the same nature as those met with in the preceding class also occur in transition rocks; and numerous and extensive beds of limestone, sometimes containing organic remains, are in some districts of frequent occurrence. Transition rocks frequently abound in ores of various descriptions, which are generally disposed in veins. The mining districts of the Leadhills and Wanlockhead, near Edinburgh, which are so rich in galena, or lead-glance, are situated in transition rocks. The rich lead and silver mines in the Hartz, and many of those in Mexico, are in rocks of the same description.

The gems which appear in so many interesting forms and relations in the strata and veins of primitive mountains, are comparatively rare in the present class.

The abundant occurrence of ores in this class of rocks; the extensive deposites of limestone, particularly of the variegated kinds so highly prized for ornamental purposes, which they contain; the fine granites and porphyries which they afford, are sufficient proofs of their importance in the arts.

The following are the rocks belonging to this class, viz. greywacke, clay-slate, limestone, trap, granite, syenite, porphyry, serpentine, gneiss, mica slate, and quartz-rock.

1. *Greywacke* is a conglomerated looking rock, with a basis of clay-slate, including angular and various shaped portions (by many considered as fragments) of clay-slate, flinty-slate, quartz, felspar, &c. and occasionally scales of mica. When the imbedded masses become small, and the mass slaty, it is named *greywacke-slate*.

2. *Clay-slate.*—This rock is of the same general nature with primitive clay slate, but differs from it in having less lustre, and in sometimes containing fossil plants and fossil shells.

3. *Limestone.*—It is more compact, and much smaller granular, and therefore has less lustre and lower translucency than the primitive limestone. It is frequently traversed by veins of calcareous spar, and often exhibits in the same bed various tints and shades of beautiful colours. Some varieties are conglomerated, forming the *brecciated marble* of artists, and others contain fossil shells and corals.

4. *Trap.*—This rock, like that of the primitive class, is principally composed of hornblende, and is sometimes associated with felspar, forming *transition greenstone*.

5. *Granite, Syenite, and Porphyry.*—These have the same composition as in the primitive class; and, independent of the characters derived from their mass, and their particular imbedded minerals and veins, are distinguished by the greywacke, with which they are associated.

6. *Gneiss and Mica Slate.*—These rocks occasionally occur associated with the greywacke and other members of this class.

7. *Serpentine and Quartz Rock.*—These very nearly resemble those of the primitive class, but are distinguished from them by their connection with greywacke, &c.

III.—*Secondary Rocks.*

This extensive and very interesting class of rocks rests immediately on those of the transition class, but when these are wanting, it rests on primitive rocks; and when the rocks of the two preceding classes occur in the same district with the secondary, the two former generally occupy a higher level. The hills of secondary districts are lower, rounder, with gentler acclivities, and fewer cliffs than those in transition districts; and their valleys are shallower, and their bottoms less inclined. Nearly all the secondary formations are more or less distinctly stratified, and the strata are more frequently horizontal, or slightly inclined, than in the older rocks. That regularity of direction of the strata, so prominent in the two preceding classes, has not been observed in the present.

Many of the secondary rocks, from their conglomerated structure, present a mechanical and not chemical aspect, and even the limestones of this series approach more nearly to the mechanical formation, than is observed in those of the preceding classes.

Secondary rocks are further particularly distinguished by the great variety and abundance of fossil organic remains which they contain. These extend throughout the whole secondary series, abounding in some formations as limestone, and in others as gypsum and trap, appearing rarely, and in small quantities. In the older formations, fossil remains of oviparous quadrupeds or lizards are met with, while, in the newer members of the series, remains of true quadrupeds, as of opossums, occur; and Werner, long ago, pointed out among the secondary formations the gradual rise of the animals in the zoological scale, according to the date of the formation in which their remains were found, viz. that in the oldest secondary rocks, the animal remains were of tribes lower in organization than those met with in formations in the middle of the series, and that those found in the newest members of the class were of animals much more perfect than those in the middle part of the series.

Coal, which we have already enumerated in the primitive and transition classes, occurs in great abundance in the secondary class, and, besides the glance-coal, the only kind of coal found in the formations older than the secondary class, contains also the black

or bituminous coal, which has much more the aspect of a vegetable formation than the glance-coal, and brown coal, a mineral of undoubted vegetable origin.

Secondary rocks are much less metalliferous than the transition and primitive, and hitherto the principal repositories of ore have been met with in the lower parts of the series, viz. in the mountain limestone, lower part of the coal formation, magnesian limestone, and in the lower part of the new red sandstone. The most abundant metals are iron, lead, and copper, and to these, as a metal of rather abundant occurrence, may be added zinc, in the form of calamine, mercury in form of cinnabar, and cobalt. It is in the secondary class of rocks that rock-salt first makes its appearance in quantity, and in the form of imbedded masses, and beds associated with gypsum and saliniferous clay.

The gems, as we have already remarked, are almost entirely confined to the primitive class, being of comparatively rare occurrence in transition rocks, and still less frequent in the rocks of this class.

From what has been already detailed, it is evident, that this class of rocks, from the variety and abundance of useful minerals it contains, must be highly interesting to those who attend to the uses of minerals. The greatest coal mines in this island, and in other countries, are situated in secondary rocks; the richest lead mines in England, the great iron mines in England and Scotland, and the salt of Cheshire, and of other countries, the vast quarries of sandstone, so important in building, and of greenstone, which furnishes the best paving stone hitherto discovered, and of limestone, so useful for various economical purposes, are situated in the formations of the secondary class.

The principal secondary rocks are sandstone, limestone, and trap, and these are arranged in various positions, and associated with other rocks.

We shall now enumerate them in the order of their relative position.

1. *First Sandstone, or Old Red Sandstone Formation.*—This is a reddish-brown sandstone, principally composed of particles of quartz, either without ground, or connected together by a basis or ground of iron shot-clay. It passes into greywacke, as on the coast of Galloway. It rests upon the rocks of the transition class.

2. *First Secondary Limestone, or Mountain Limestone*—is a compact bluish-grey limestone, full of encrinites, corals, and shells; often contains caverns, and sometimes alternates with the sandstone, slate-clay, and other rocks of the coal formation. It lies immediately on the old red sandstone.

3. *Coal Formation.*—This is an alternation of grey and white sandstone, bituminous shale and slate clay, clay ironstone, limestone, and coal. The whole together form a group or set of rocks, termed the coal formation. It rests on the mountain limestone.

4. *Second Secondary Limestone, or Magnesian Limestone of Geologists.*—This formation, as it appears in England, is generally a granular, sandy, and glimmering limestone, which contains a considerable portion of carbonate of magnesia. It occasionally contains gypsum and rock-salt. It lies immediately over or above the coal formation.

4. *Second Sandstone, or New Red Sandstone Formations.*—This sandstone is principally composed of particles of quartz, set in a reddish-brown clayey basis or ground. It is looser in its nature than the old red sandstone, and its colour wants the bluish tint which occurs in the old red sandstone. It is sometimes conglomerated, particularly where near the magnesian limestone, when it contains fragments of the subjacent strata. It abounds in beds of red and blue marl and clay, and in these there are occasionally imbedded masses and beds of gypsum, and rock-salt. It is here, and in the magnesian limestone formation, that the greatest masses of rock-salt are met with, and it is in these formations of the secondary series that the principal salt mines are situated It rests immediately on the second secondary or magnesian limestone.

5. *Third Secondary Limestone, or the Oolite or Shell Limestone Formation, or Jura Formation.*—The lower members of this formation are blue, grey, and white slaty limestone, with blue slaty marl, and clay, in which are variously shaped masses of chert. These are known under the name *Lias*. Above these, still in this formation, there are alternations of beds of oolite limestone, shelly limestone, calcareous sandstone, various marls, clays, and fuller's earth. It rests upon the second or new red sandstone.

6. *Third Sandstone Formation, or the Green Sand Formation.*—This formation extends through a large portion of the south-eastern parts of England. Its characteristic member is a siliceous sandstone, abounding in grains of a substance resembling green earth or augite. Besides this sandstone, the formation contains beds of a coarse shelly limestone, of various clays, fuller's earth, and of iron sand. It rests upon the third limestone or oolite formation.

7. *Fourth Limestone Formation, or Chalk Formation.*—The lower part of this formation is composed of a grey clayey chalk, without flints, and of grey-coloured clays and marls. Immediately above is a hard chalk, with few flints, and above is the softer chalk in which flints and organic remains abound.

8. *Brown Coal Formation.*—In this formation, which appears to rest upon chalk, brown coal occurs in great masses, associated with clays and marls, and occasionally with glance coal. The English *pudding-stone* appears to rest immediately, either on the brown coal or the chalk formations.

9. *Paris Formation.*—Under this head we include the series of beds of clay, marl, limestone, gypsum, sand, and sandstone, that occur in the basin of Paris, and also in that of the Isle of Wight and other quarters. They lie above chalk, and higher than the brown coal, and are divided into sets; two characterized by the presence of fresh water shells, and remains of quadrupeds, are named *fresh water formations*; and other two, containing principally salt water shells, are named *marine formations*.

10. *Secondary Trap Rocks.*—The rocks of this division have been described by many geologists as lavas. They occur in imbedded masses, beds and veins, in many of the formations already described, and hence, in order to prevent repetition, we have brought them together under one division. They are principally composed of augite, with occasional

Geognosy || Monaghan.

hornblende, and felspar; the augite occurs in all its states from the crystalline to the earthy or powdery condition, and the felspar appears in all the different states from clay stone and clay to the crystalline state. The following are the secondary trap rocks: *Basalt, greenstone, syenite, amygdaloid, porphyry,* and *tuffa*, which are already described in the *Encyclopædia*.

IV. *Alluvial Rocks*.

These are the various clays, loams, marls, sands, gravels, rolled masses, &c. which lie over the other more solid rocks, and which owe their origin to the agency of the waters of the ocean, of rivers, lakes, and springs. They are divided into those called *diluvian*, because they seem to have been formed at the time of the deluge; such are the clays, sands, and loams, containing the remains of elephants, rhinoceri, &c. and of those loose blocks sometimes 50,000 square feet in magnitude, and found at great distances from their native places; and into those clays, loams, sands, and gravels, which are daily formed on the face of the earth by the agency of the waves of the ocean, and the actions of rivers, lakes, and springs, and which have been named *post-diluvian*.

V. *Volcanic Rocks*.

All those rocks which owe their present characters to the action of subterranean heat, or to that emanating from beds of coal, are named volcanic.

They are divided into *pseudo-volcanic*, and *true volcanic*. The pseudo-volcanic rocks are clays and iron stones, indurated, and partly melted by the heat from burning beds of coal. The true volcanic rocks are those which have flown in streams, or have been projected in the form of dust or gravel, from the craters or sides of volcanoes in a state of activity. These are the various kinds of *lava, tuffa, and volcanic dust*. (M M. M)

MOLLUSCA. See ADDENDUM to this Volume.

Situation and Extent.

MONAGHAN, a county of Ireland, in the province of Ulster, extending about 38 English miles from north to south, and 24 miles from east to west, contains 509 English square miles, or 325,760 English acres. It is situated in the diocese of Clogher, and ecclesiastical province of Armagh, and is divided into five baronies and 21 parishes. Its boundaries are Armagh and Tyrone on the north; Armagh, Meath, and Louth, on the east; Cavan and Louth on the south; and Fermanagh on the west.

Surface, &c.

The surface of this district is marked by a succession of low grounds and detached hills, which, in other quarters of no great height, attain a considerable elevation on the borders of Tyrone and Armagh; and a considerable space is occupied with bogs and small lakes. It has not the advantage of being much sheltered and ornamented with woods and inclosures, which both the soil and climate are said to require; yet it contains a few handsome seats, with considerable plantations around them; and towards the middle of the county there is a considerable tract of fertile land, with a subsoil of limestone gravel. In other parts, though the soil be rather wet, it is far from being unproductive. The rivers and rivulets are the Blackwater, the Fane, the Lagan, the Ballyhays, and a few others. Some of these flow westward to Loch Carne, and others eastward into the county of Louth; but none of them are of such importance as to require particular notice. The Blackwater is for some distance the boundary between this county and Tyrone. Limestone, sandstone, and marl, are spread throughout a great part of it. Some valuable quarries of sandstone have been long wrought among the hills on the north, near the boundary with Tyrone. In the same quarter very good millstones have been raised.

Estates.

Monaghan contains a few large estates, but the greater part of it is divided into small ones, many of which do not yield a free income equal to the ordinary wages of labour. A few years ago, there was only 172 freeholders of L. 50 and upwards, out of nearly 6000. Most of the considerable proprietors are absentees, and very little of the landed property is in the hands of Catholics.

Farms.

Farms were so small a few years ago, as not to average ten Irish acres over the whole county; and the management, as might be expected, was exceedingly unskilful and unproductive. The spade was used much more than the plough; the latter being an implement which, with the team required to work it, and the party to attend and direct it, could be brought into action only by the united efforts of several tenants. The general term of leases is 21 years, and a life, or sometimes three lives. The principal crops are oats, potatoes, and flax, with wheat and barley in a small proportion; these last, however, extend over a much greater tract now than they did a few years ago. They make a good deal of butter, but there are no large dairies. Goats are in greater numbers than sheep, which is of itself a sufficient proof of the low state of its agriculture.

Manufactures.

Monaghan, however, has been long distinguished for its linen manufacture, which is said to have averaged, twenty years ago, about L. 200,000 a-year. It is carried on by the greater portion of the inhabitants of both sexes, all the small farmers being also weavers. This county has no other manufacture worth noticing, and little besides that can be spared for export, being more populous for its extent, owing to this minute division of land, than many others that are more productive. The towns and villages are Monaghan, the county town, Clones, Carrickmacross, Castle Blaney, Drum, Castle Shane, Ballybay, and Emyvale. The first sent two members to the Irish Parliament; but all of them being inconsiderable places, they have no share in the elections for the Parliament of the United Kingdom, to which the county itself sends two members. The Catholics are said to be to the Protestants as about 5 to 1, most of the latter being Presbyterians. In 1790, Monaghan contained 118,000 inhabitants, which is nearly 232 for every English square mile.—See the general works quoted under the former Irish counties, and Sir Charles Coote's *Statistical Survey of Monaghan*.

(A.)

MONEY.

The term Money* is used to designate whatever commodity the inhabitants of any particular country, either voluntarily or by compulsion, accept as an equivalent for their labour, and for all the commodities they have to dispose of.

Sect. I.—*Circumstances which led to the use of money—Principal properties that every commodity used as such ought to possess—Not a sign or a measure of value, but a real equivalent.*

Circumstances leading to the use of Money

A country in which the division of labour was unknown, and where every individual or family directly produced the commodities necessary for his or their consumption, would have no exchanges, and consequently no money. But, after the division of labour has been established, the introduction of money becomes necessary, or, at least, highly advantageous. In such a state of society, a very small part only of a man's wants are directly supplied from the produce of his own labour. The greater part are indirectly supplied by exchanging that surplus part of the produce of his own labour which exceeds his own consumption, for such parts of the produce of other men's labour as he has occasion for, and they are willing to part with. Every man thus lives by exchanging, or becomes in some measure a merchant, and the society itself grows to be what is properly a commercial society.

"But when the division of labour first began to take place, this power of exchanging must frequently have been very much clogged and embarrassed in its operations. One man, we shall suppose, has more of a certain commodity than he himself has occasion for, while another has less. The former, consequently, would be glad to dispose of, and the latter to purchase, a part of this superfluity. But, if this latter should chance to have nothing that the former stands in need of, no exchange can be made between them. The butcher has more meat in his shop than he himself can consume, and the brewer and the baker would each be willing to purchase a part of it; but they have nothing to offer in exchange except the different productions of their respective trades, and the butcher is already provided with all the bread and beer which he has immediate occasion for. No exchange can, in this case, be made between them. He cannot be their merchant, nor they his customers; and they are all of them thus mutually less serviceable to one another. In order to avoid the inconveniency of such situations, every prudent man, in every period of society, after the first establishment of the division of labour, must naturally have endeavoured to manage his affairs in such a manner as to have at all times by him, besides the peculiar produce of his own industry, a certain quantity of some one commodity or another, such as he imagined few people would be likely to refuse in exchange for the produce of their industry."—(*Wealth of Nations*, Vol. I. p. 34. 8vo Ed.)

This commodity, whatever it may be, is *money*.

Commodities used as Money in different countries.

An infinite variety of commodities have been used as money in different countries and states of society. Those nations who chiefly subsist by the chace, such as the ancient Russians, and the greater part of the Indians who now occupy the uncultivated portion of America, use the skins of wild animals as money.† In the pastoral state of society cattle are most commonly used for that purpose. Homer mentions that the armour of Diomed cost only *nine* oxen, while that of Glaucus cost *one hundred*. (*Ilias*, lib. 6, lin. 235.) The etymology of the Latin word (*pecunia*), signifying money, and of all its derivatives, proves that cattle (*pecus*) had been the primitive money of the Romans.‡ They had also been used as such by the ancient Germans; for their laws uniformly fix the amount of the penalties to be paid for particular offences in cattle. (Storch *in loco citato*.) In remoter ages corn was very generally used, in agricultural countries, as money; and even now, it is by no means uncommon to stipulate for corn rents and wages. Other commodities have been used in different countries. Salt is said to be the common money of Abyssinia (*Wealth of Nations*, I. p. 35); a species of shells, called *cowries*, gathered on the shores of the Maldive Islands, are used in smaller payments throughout Hindostan, and form the only money of extensive districts in Africa.§ Dried fish forms the money of Iceland and Newfound-

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* Etymologists differ in opinion respecting the derivation of the word money. Some contend that it comes from *Monere*,—to admonish, to inform,—because the stamp impressed on coined money indicates its weight and fineness. (Bouteroue, *Recherches sur les Monnoyes de France*, p. 1.) And others that it originates in the circumstance of silver being first coined at Rome in the temple of admonishing Juno—*Juno Moneta*. (Suidas, *in voce* Μονητα.)

† Storch, *Traité d'Economie Politique*, Tome III. p. 16; and Ulloa, *Mémoires Philosophiques sur l'Amerique*, Tome II. p. 100.

‡ Morellet, *Prospectus d'un Nouveau Dictionnaire de Commerce*, p. 115.

§ "Dans les pays ou le cuivre a trop de valeur pour pouvoir représenter celle des plus menues denrées, on est encore obligé de lui substituer quelq'autre matière plus commune. C'est cette circonstance qui a fait adopter aux Indiens l'usage des *cauris* en guise de petite monnoie. Cet usage pourroit paroître étrange dans les pays aussi riches et d'une civilisation aussi ancienne que le Bengale et l'Indoustan: mais le cuivre y est si rare, et les vivres y sont à si bon marché, q'une pièce de la valeur de 1 cop. et ¼ (about a halfpenny

Money.

calculated, the wealth of civilized communities." (Torrens *on the Production of Wealth*, p. 305.)

Coined Money not a sign, or a measure of value.

But, whatever may be the advantages attending the use of coined money, and they are great and obvious, it is necessary to observe, that its introduction does not affect the nature of exchanges. Equivalents are still given for equivalents. The exchange of a quarter of corn for an ounce of pure unfashioned gold bullion, is undeniably as much a real barter, as if it had been exchanged for an ox, or a barrel of beer. But, supposing the metal to have been formed into a coin,—that is, marked with a stamp indicating its weight and fineness, it is plain that circumstance could have made no change in the terms of the barter. The coinage would save to both parties the trouble of weighing and assaying the bullion, but it could do nothing more. *A coin is merely a piece of metal of a known weight and fineness;* and the commodities exchanged for it are always held by the parties to be of equal value. And yet these simple and obvious considerations have been very generally overlooked. Coined money, instead of being viewed in the same light as other commodities, has been looked upon as something quite mysterious. It was said to be both a *sign* and a *measure* of value. In truth, however, it is neither the one nor the other. A guinea is not a sign, it is the thing signified. A promissory note, payable at some stated period, may not improperly be considered as the *sign* of the specie which is to be paid for it; but that specie is itself a commodity possessed of real exchangeable worth. It is equally incorrect to call money a measure of value. Gold and silver do not measure the value of commodities, more than commodities measure the value of gold and silver. Every thing possessed of value may either measure, or be measured by, every other thing possessed of value. When one commodity is exchanged for another, each is the measure of the value of the other. If the quartern loaf sold for a shilling, it would be just as correct to say, that a quartern loaf measured the value of a shilling, as to say that a shilling measured the value of a quartern loaf.

Use of Gold and Silver as standard estimating the value of commodities.

The quality of serving as a measure of value is, therefore, equally inherent in every commodity. But the *slow* degrees by which the precious metals change their value, renders them peculiarly well fitted for forming a *standard*, by which to compare the values of other and more variable commodities. To this standard reference is almost always made in estimating the value of the products of every civilized country. We do not say, that one man is worth a thousand acres of land, and that another is worth a thousand sheep; but we ascertain for how much gold or silver the land and the sheep would exchange, and then say, that their proprietors are worth so much money. In this, however, there is certainly nothing mysterious. We merely compare the value of one commodity with the value of another commodity; and as coin or money has been found to be the most convenient standard of comparison, the value of all other commodities is usually estimated in it.

Proof of the non-existence of an abstract or ideal standard.

It is obvious, from this statement, that the terms of the exchange of one commodity, or set of commodities, for another may be adjusted, with reference to money, without any money being actually in the possession of either of the parties making the exchange. If a horse, for example, had commonly sold for ten pieces of silver, an ox for five pieces, and a sheep for one piece, it would mark their relative values to each other, and the animals might be exchanged, on this footing, without the intervention of money. The frequent recurrence of transactions of this kind seems to have given rise to the notion of an *abstract* or *ideal* standard of value. Thus, instead of saying that a horse is worth ten pieces of silver, an ox five pieces, and a sheep one piece, it has been contended that it might equally have been said that they were respectively worth ten points or units, five points or units, and one point or unit; and that, as the proportional values of commodities might be as clearly expressed in these *arbitrary* terms as in money, or any commodity possessed of real value, the use of the latter, as a standard, might be advantageously dispensed with, and a set of abstract terms adopted in its stead. This, however, is entirely and completely mistaking the nature and object of a standard. A standard is *not* intended to mark the known relations between different commodities, but to *enable us easily to discover those which are unknown.* Now, although a series of arbitrary terms may serve extremely well for the first of these purposes, it is utterly impossible that they can ever serve for the second. This, however, is exclusively the object of a standard; and it is quite plain that nothing can be used as such which is not possessed of the same properties with those with which it is to be compared. To measure length, a standard must have length, to measure value it must have value. The value of commodities is ascertained by separately comparing their cost with the cost of money, and we express their relation to each other by simply stating the result of our inquiries; that is, by mentioning the number of livres, of pounds, or of fractions of a pound, they are respectively worth. And, when any new commodity is offered for sale, or when any change is made in the cost of an old one, we ascertain their relation to the rest, by merely comparing them with a livre or a pound. It is plainly impossible, however, that we could have done this, had the terms livre, or pound, been purely arbitrary, and referable to no really valuable commodity! We might as well try to estimate distances by an imaginary inch, or an imaginary foot, as to estimate prices or values by an imaginary shilling, or an imaginary guinea. When we say that an ox is worth five pounds, and a sheep only one, we really mean no more than that, when an ox and a sheep are compared together, that is, when the one *serves as a standard by which to estimate the value of the other*, one ox is found to be worth five sheep. But, suppose that we wish to ascertain what is the relative value of some other commodity,—of a pound of tea, for example,—to oxen or sheep, of what use would it be to be told that one ox was worth five sheep, or that, when the value of an ox was represented by the imaginary term "five pounds," the value of a sheep was represented by the imaginary term "one pound?" It is not the relation between oxen and sheep, but the relation between these animals and tea, that we are desirous of learning. And, al-

though this relation may be learned by comparing the cost of producing oxen and sheep with the cost of producing tea, or by ascertaining for how much of some other commodity an ox, a sheep, and a pound of tea, will respectively exchange, it is obvious it could never be learned by comparing them with a set of arbitrary terms or symbols! It would not, in truth, be more absurd to attempt to ascertain it by comparing them with the hieroglyphics on an Egyptian sarcophagus. Nothing that *will not exchange for something else*, can ever be a standard, or measure of value. Commodities are always compared with commodities, and not with abstract terms. Men go to market with real values, and not with the signs of values, in their pockets. And it is to something possessed of real worth—to the *gold* contained in a guinea, and not to the *word* guinea, that they always have referred, and must continue to refer, in estimating value. *

In common mercantile language, the exchanging of money for a commodity is termed *buying*, and the exchanging of a commodity for money *selling*. *Price*, unless when the contrary is particularly mentioned, always means the value of a commodity, estimated in money.

Having thus endeavoured to explain the circumstances which led to the introduction of money, and to show what it really is, and what it is not, we shall now proceed to investigate the laws by which its exchangeable value is regulated. It is chiefly from the prevalence of erroneous opinions on this subject, that the true theory of money has been so long misunderstood.

SECT. II.—*Circumstances which Regulate the Exchangeable Value of Money.*

This branch of our subject naturally divides itself into two parts; 1*st*, An inquiry into the principles which regulate the exchangeable value of money

* The following passage of Montesquieu has been often referred to in proof of the existence of an ideal standard:—" Les noirs de la côte d'Afrique ont un signe des valeurs sans monnoie; c'est un signe purement ideal fondé sur le degré d'estime qu'ils mettent dans leur esprit à chaque marchandise, à proportion du besoin qu'ils en ont—une certaine denrée, ou marchandise vaut trois macutes; une autre, six macutes; une autre, dix macutes: c'est comme s'ils disoient simplement trois, six, dix. *Le prix se forme par la comparaison qu'ils font de toutes les marchandises entre elles:* pour lors, il n'y a point de monnoie particulière, mais *chaque portion de marchandise est monnoie de l'autre.*"—(*Esprit des Loix*, Livre XXII. cap. 8.)

But, instead of giving any support to the notion of an abstract standard, this passage might be confidently referred to in proof of its non-existence. Had Montesquieu said that the blacks determined the relative values, or prices, of commodities, by comparing them with the arbitrary term *macute*, the statement, though false, would have been, at least, in point. But he says no such thing. On the contrary, he states distinctly, that the relative values of commodities (marchandises) are ascertained by comparing them *with each other* (entre elles), and that it is merely the result of the comparison that is expressed in arbitrary terms!

So much for the weight to be attached to this statement, supposing it to be well-founded. The truth is, however, that the term *macute* is not really arbitrary, and employed only to mark an ascertained proportion, but that it has a reference to, and is, in fact, the *name of an intrinsically valuable commodity.* " On a bien dit," says l'Abbé Morellet, " que ce mot macute etoit une expression abstraite et generale de la valeur, et cela est vrai au sens ou nous l'expliquerons plus bas; mais on n'a pas remarqué que cette abstraction a été consequente et posterieure à l'emploi du mot macute pour signifier une *marchandise, une denrée réelle à laquelle on avoit longtems comparé toutes les autres.*

" Macute en plusieurs lieux de la côte d'Afrique, est encore le nom d'une certaine étoffe—' *Chez les negres de la côte d'Angola*,' dit le voyageur Angelo, ' *les macutes sont des pieces de nattes d'une aune de long*,'—Jobson dit aussi que les macutes sont *une espece d'etoffe.*

" Les étoffes ont toujours été l'objet d'un besoin tres-pressant chez des peuples aussi barbares, depourvus de toute espèce d'industrie.—Les nattes en particulier leur sont de la plus grande necessité. Elles sont divisées en morceaux peu considerables et d'une petite valeur—elles sont tres-uniformes dans leurs parties, et les premières qu'on a faites auront pu etre semblables les unes aux autres, et d'une bonté égale, sous la même dénomination—toutes ces qualités les ont rendu propres à devenir la mesure commune des valeurs."—(*Prospectus d'un Nouveau Dictionnaire de Commerce*, p. 121.)

The following extract from Park's *Travels* gives an example of a similar kind: " In the early intercourse of the Mandingoes with the Europeans, the article that attracted most notice was iron. Its utility in forming the instruments of war and husbandry made it preferable to all others; and iron soon became the measure (standard) by which the value of all other commodities was ascertained. Thus a certain quantity of goods, of whatever denomination, appearing to be equal to a bar of iron, constituted, in the trader's phraseology, a bar of that particular merchandise. Twenty leaves of tobacco, for instance, were considered as a *bar* of tobacco; and a gallon of spirits (or rather half spirits and half water) as a *bar* of rum; a bar of one commodity being reckoned equal in value to a bar of another commodity. As, however, it must unavoidably happen, that, according to the plenty or scarcity of goods at market, in proportion to the demand, the relative value would be subject to continual fluctuation, greater precision has been found necessary; and, at this time, the current value of a single bar of any kind is fixed by the whites at *two shillings Sterling*. Thus, a slave, whose price is L.15, is said to be worth 150 bars."—*Travels in the Interior of Africa*, 8vo edit. Vol. I. p. 39.)

when the power to supply is not monopolized; and, 2*d*, An inquiry how far these principles are liable to be affected by the operation of monopoly.

Cost of Production regulates the exchangeable value of Money, when the power to supply it is not monopolized.

I. There does not now seem to be much room for difference of opinion respecting the circumstances regulating the value of the precious metals, and their distribution throughout the various countries of the globe. Bullion is a commodity, on the production of which competition operates without restraint. It is not subjected to any species of monopoly, and its value in exchange must, therefore, be entirely regulated by the cost of its production, that is, by the comparative quantities of labour necessary to bring a given quantity of it to market.

If, in every stage of society, it required precisely the same quantity of labour to produce a given quantity of bullion, its value would be *invariable;* and it would constitute a standard by which the variations in the exchangeable value of all other commodities could be *correctly* ascertained. But this is not the case either with bullion or any other commodity. And its value, in the same way as the value of any other commodity, fluctuates not only according to the greater or less productiveness of the mines from which it is extracted, but also according to the comparative skill of the miners, and the improvements of machinery.

M. Say has, in his valuable work on *Political Economy*, a chapter, "De la valeur que la qualité d'etre monnoie ajoute à une marchandise." But a little reflection will convince us, that M. Say is mistaken, and that the circumstance of the precious metals being used as money, or as a circulating medium, cannot affect their exchangeable value. M. Say reasons on the common hypothesis, that an increase of demand is always productive of an increase of value,—an assumption totally at variance with principle and with fact. Value depends exclusively upon the cost of production; and it is obvious, that the cost of producing a commodity may be diminished at the same time that the demand for it is increasing. This is so plain a proposition, as hardly to require to be substantiated by argument. And a reference to the case of cotton goods, the price of which has, notwithstanding the vast increase of demand, been constantly on the decline during the last half century, is enough to convince the most sceptical of the extreme erroneousness of M. Say's conclusion. But, with regard to the particular case of the precious metals, it is clear the capital devoted to the production of gold and silver must yield the common and ordinary rate of profit; for, if it yielded more than this rate, there would be an influx of capital to the mining business; and, if it yielded less, it would be withdrawn, and invested in some more lucrative employment. And hence, though the demand for gold and silver should, from the adoption of some other commodity as an instrument of exchange, gradually become less, the value of the precious metals would not, on that account, be reduced. A smaller supply would, indeed, be annually brought to market, and a portion of the capital formerly engaged in the mining, refining, and preparing of the metals would be disengaged; but as the whole stock thus employed yielded only the average rate of profit, the portion which is not withdrawn must continue to do so,—or, which is the same thing, gold and silver must still continue to sell for the same price. It is no doubt true, that where mines are, as they almost always are, of different degrees of productiveness, any great falling off in the demand for bullion might, by rendering it unnecessary to work the inferior mines, enable the proprietors of the richer mines to continue their work, and to obtain the ordinary rate of profit on their capitals, by selling their bullion at a reduced price. In this case the value of bullion would be really diminished; but it would be diminished, not because there was a falling off in the demand, but because there was a *greater facility of production*. On the other hand, an increased demand for bullion, whether it arose from the general suppression of paper money, or from a greater consumption of gold and silver in the arts, or from any other cause, would not—unless it was necessary, in order to procure the increasing supply, to have recourse to mines of an inferior degree of productiveness—be accompanied by any rise of price. If the mines from which the additional supplies were to be drawn were less productive than those already wrought, more labour would be necessary to procure the same quantity of bullion, and, of course, its price would rise. But, if no such increase of labour was required, its price would remain stationary, though a thousand times the quantity formerly required should be demanded.

After gold and silver have been brought into the market, whether they shall be converted into coin or into manufactured commodities, depends entirely on a comparison of the profits that may be derived from each operation. No person would take bullion to the mint if he could realize a greater profit by disposing of it to a jeweller; and no jeweller would work up bullion into plate, if he could turn it to greater account by converting it into coin. The value of bullion and coin must, therefore, in countries where the expences of coinage are defrayed by the state, nearly correspond. When there is any unusual demand for bullion in the arts, coin will be melted down; and when, on the contrary, there is any unusual demand for coin, plate will be sent to the mint, and the equilibrium of value maintained by its fusion.

It appears, therefore, that while competition is allowed to operate without restraint on the production of gold and silver, they are, like all other commodities, produced in similar circumstances, valuable only in proportion to the cost of their production,—that is, in proportion to the quantity of labour necessarily expended in bringing them to market. And hence, while they constitute the currency of the commercial world, the price of commodities, or their value compared with gold or silver, will vary, not only according to the variations in the exchangeable value of the commodities themselves, but also according to the variations in the exchangeable value of the gold or silver with which they are compared.

The proportion between the supply and demand regulates the exchange-

II. But if competition was not allowed to operate on the production of the precious metals, if they could be monopolised and limited in their quantity, their exchangeable value would no longer be regulated by

the same principles. If, after the limitation, they still continued to be used as money, and if, in consequence of the improvement of society, manufactured commodities and valuable products should be very much multiplied, the exchanges which this *limited* amount of money would have to perform would be proportionably increased; and, of course, a proportionably smaller sum would be appropriated to each particular transaction; or, which is the same thing, money prices would be diminished. Whenever the supply of money is *fixed*, the amount of it, given in exchange for commodities, must *vary inversely as the demand, and can be affected by nothing else*. If double the usual supply of commodities were brought to market in a country with a limited currency, their money price would be reduced one-half; and if only half the usual supply were brought to market, it would be doubled; and this, whether the cost of their production had increased or diminished. No one would, in these circumstances, exchange the produce of his industry for money, on the ground that money was itself a commodity capable of being advantageously used in the arts, or that an equal quantity of labour had been expended on its production; but because it was the universal equivalent used by the society, and because, as such, it would be willingly received in exchange for the produce of the industry of others. The remark of Anacharsis, the Scythian, that gold and silver coins seemed to be of no use but to assist in numeration and arithmetic (Hume's *Essay on Money*), would, if confined to a strictly *limited currency*, be as just as it is ingenious. Guineas, sovereigns, livres, dollars, &c. would then really constitute mere tickets or counters, to be used in computing the value of property, and in transferring it from one individual to another. And as small tickets, or counters, would serve for this purpose quite as well as large ones, it is unquestionably true, that a debased currency might, by first reducing, and then limiting its quantity, be made to circulate at the value it would bear if the power to supply it was unrestricted, and if it were possessed of the legal weight and fineness; and that, by still further limiting its quantity, it might be made to pass at any higher value.

Thus it appears, that whatever may be the *material* of the money of any country, whether it consist of gold, silver, copper, iron, leather, salt, cowries, or paper, and however destitute it may be of all *intrinsic* value, it is yet possible, by *sufficiently limiting its quantity*, to raise its value in exchange to any conceivable extent.

Suppose the money of Great Britain to consist of 50,000,000 or 60,000,000 of one pound notes, and that we are prevented from increasing or diminishing this sum, either by issuing additional notes or coins, or by withdrawing the notes already in circulation, it is obvious that the quantity of commodities for which such notes would exchange, would increase or diminish precisely according to the increase or diminution of the quantity of commodities brought to market. If we suppose that ten times the amount of products that were offered for sale when the limitation of the currency took place, are offered for sale ten or twenty years afterwards, and that the rapidity of circulation has continued the same, prices will have fallen to *one-tenth* of their former amount; or, which is the same thing, the exchangeable value of the paper money will have increased in a tenfold proportion;—and, on the other hand, if the products brought to market had diminished in the same proportion, the exchangeable value of the paper money will have been equally reduced.

The principles we have now stated are of the utmost importance to a right understanding of the real nature of money. Previously to the publication of Mr Ricardo's great work, every writer of authority on political economy had maintained that the value of money depended entirely on the relation between its amount and the demand. But this is true only of a gold or silver currency when its quantity is *limited*, and of a currency formed of materials having little intrinsic worth, as paper, when its quantity is *limited*, and when it is not made convertible, at the pleasure of the holder, into some more valuable commodity, whose production is under no restraint. It is obvious, indeed, without any reasoning on the subject, that the value in exchange of a currency possessed of little or no real value, can only depend on the proportion which its total amount bears to the amount of the commodities brought to market, or to the demand. And wherever a currency of this kind, or a limited gold currency, is in circulation, the common opinion that the prices of commodities are regulated exclusively by the proportion between the quantity of them brought to market, and the supply of money, and that any considerable increase or diminution of either will proportionably affect prices, is quite correct. It is altogether different, however, with a currency consisting of gold or silver, or of any other commodity possessed of considerable value, and the supply of which may be increased to an unlimited extent by the operation of unrestricted competition.

The fluctuations in the supply of, and demand for, such money, can have no permanent effect on its exchangeable value; this depends exclusively on the comparative *cost of its production*. If a guinea commonly exchanges for a couple of bushels of wheat, or a hat, it is because the same labour has been expended on its production, as on that of either of these commodities; while, if with a limited and inconvertible paper money, these commodities exchange for a *guinea note*, it would only be because such was the proportion which, as *a part of the general mass of commodities offered for sale, they bore to the supply of paper or money in the market*. This proportion would, it is evident, be not only immediately, but permanently, affected by an increase or diminution of the supply either of paper or of commodities. But the relation which commodities bear to a freely supplied metallic currency, could not be permanently changed, except by a change in the cost of producing the commodities or the metals.

Our readers must not conceive from what we have now stated, that we mean to contend that the value of gold or silver is never affected by variations in the supply and demand. Such an opinion would be al-

Money.

together erroneous. At the same time it must be admitted, that their value is much less affected by such variations, than the value of almost any other commodity. Their great durability precludes the possibility of any sudden diminution of their quantity, while the immense surface over which they are spread, and the various purposes to which they are applied, prevent any unusual productiveness of the mines from speedily lowering their value. An extraordinary event, such as the discovery of America, or the establishment of an intercourse between a country where bullion bore a high value, and one where its value, from the greater facility of its production, was comparatively low, would, by causing a sudden exportation and importation, raise its value in the one country, and sink it in the other. But such events must necessarily be of very rare occurrence. And although the value of gold and silver must, because of the different degrees of productiveness of the mines, to which, in the progress of society, recourse must be had,—and because of the successive improvements in the art of mining and working metals, be very different at distant periods—it is abundantly uniform to secure us against all risk of sudden and injurious fluctuations.

Such are the circumstances which regulate the value of money, both when the power to supply it is not subjected to any species of monopoly, and when it is monopolised and limited. In the former case, its value depends, like the value of all other commodities, on the cost of its production; while, in the latter case, its value is totally unaffected by that circumstance, and depends entirely on the extent to which it has been issued, compared with the demand.

The conclusions deducible from the fundamental principle we have thus endeavoured to establish, are of the utmost importance. A metallic currency, on the coinage of which a high seignorage or duty was charged, and a paper currency not convertible into the precious metals, were occasionally seen to circulate at the same value with a metallic currency of full weight, and which had been coined at the expence of the state. But no rational, satisfactory, or consistent explanation of these apparently anomalous results could be given until the effects produced by limiting the supply of money had been accurately observed and appreciated. Now, however, that this has been done, all these difficulties have disappeared. The theory of money has been perfected, and we are enabled to show what, under any given circumstances, would be the effect of imposing a seignorage, or of issuing an inconvertible paper currency.

SECT. III.—*A moderate Seignorage on Coined Money shown to be advantageous.—Principles which should regulate its amount.* *

Reasons why a Seignorage should be imposed on Coined Money.

The government of almost every country has retained the power of coining exclusively in its own hands. In antiquity this privilege was reserved merely to prevent the confusion that must have attended the too great multiplication of coins of different denominations, had individuals been permitted to issue them at their pleasure, and to give the public a greater security that the stamp should truly indicate the weight and fineness of the metal.† But in modern Europe it has been used not only as a means of affording a better guarantee to the public, but also of increasing the revenues of the state. Of the expediency of deriving a revenue from this source, much difference of opinion has, however, existed. Many able economists have contended that the state ought in no circumstances to charge any duty on coined money; and that the expences of the mint ought always to be defrayed by the public. In this opinion we cannot concur; and we think the reasoning of Dr Smith, in favour of a moderate seignorage, quite unanswerable. No good reason has yet been given why those who want coins should not have to pay the expences of manufacturing them. Coinage, by saving the trouble and expence attending the weighing and assaying of bullion, indisputably adds a real value to the precious metals. It renders them fitter to perform the functions of a circulating medium. A guinea is of greater real value than a piece of pure unfashioned gold bullion of the same weight; and for this plain reason, that while it is equally well adapted with the bullion for being used in the arts, it *is much better adapted for being used as money*, or in the exchange of commodities. Why then should the Government be prevented from charging a *seignorage*, or duty on coined money, equal to the expences of the coinage, or, which is the same thing, to the value which it adds to the bullion? Those who contend that the State ought to defray the expence of the coinage, might, with equal cogency of reasoning, contend that it ought to defray the expence of manufacturing gold and silver tea-pots, vases, &c.! In both cases, the value of the raw material, or bullion, is increased by the cost of workmanship. And it is only fair and reasonable, that those who carry bullion to the mint ought, equally with those who carry it to the jewellers, to be obliged to pay the expences necessarily attending its conversion into coin.

But there are other reasons why a seignorage, to this extent at least, ought to be exacted. In countries where the expences of coinage are defrayed by the State, an ounce of coined gold or silver, and an ounce of gold or silver bullion, must be very nearly of the same value. And hence, whenever it became profitable to export the precious metals, money, in the coinage of which a considerable expence had been incurred, would be sent abroad indifferently with bullion. It has indeed been attempted, by pro-

* Seignorage, strictly speaking, means only the *clear revenue* derived by the state from the coinage; but it is now commonly used to express every deduction made from the bullion brought to the mint to be coined, whether on account of duty to the state, or of the expence of coinage (properly *brassage*). We always use the phrase in its more enlarged sense.

† Le Blanc, *Traité Historique des Monnoyes de France*, p. 90, ed. Amst. 1692.

hibiting the exportation of coins, to prevent the loss which might thus be occasioned to the public; but these efforts have proved singularly ineffectual. Admitting, however, that it is possible, which most certainly it is not, to prevent or even materially to limit the clandestine exportation of coins, it is conceded, on all hands, to be quite nugatory to attempt to prevent their conversion into bullion. In this there is almost no risk. And the security with which their fusion can be effected, and the trifling expences attending it, will always enable them to be melted down and sent abroad whenever there is any unusual foreign demand for the precious metals. This exportation would, however, be effectually prevented by the imposition of a seignorage or duty, equal to the expence of the coinage. The coins being, by this means, rendered more valuable than bullion, they would be always kept at home in preference: And if, as Dr Smith has observed, it became necessary, on any emergency, to export coined money, it would be again reimported. Abroad the coins would be only worth so much bullion; while at home they would be worth this much and the expence of coinage besides. There would, therefore, be an obvious inducement to bring them back, and the supply of currency would be maintained at its proper level, without its being necessary for the mint to issue fresh coins.

Besides relieving the country from the useless expences attending the coinage of such money as may be melted down and exported to other countries as an article of commerce, the imposition of a moderate seignorage would either totally prevent, or at least lessen that fusion of the heavier coins, which must always take place whenever a currency, the supply of which is not restricted, becomes degraded or deficient in weight. Previous to the great recoinage in 1773, the quantity of bullion contained in the greater proportion of the gold coins in circulation was reduced nearly 2 *per cent.* below the mint standard; and, of course, the price of gold bullion, estimated in this degraded currency, rose 2 *per cent.*, or from L.3, 17s. $10\frac{1}{2}$d., its mint price, to L.4. This, however, was too minute a difference to be taken into account in adjusting the ordinary business of buying and selling. And the possessors of coins fresh from the mint, or of coins of full weight, not obtaining more of the general mass of commodities in exchange for them, than they obtained for the lighter coins in circulation, sent the former to the melting pot, and then sold them as bullion. But it is easy to see that this fusion of the coins would have been effectually prevented had they been loaded with a seignorage of 2 *per cent.* The heavy coins could not then have been melted without losing the additional value given them by the seignorage; and as we have supposed this to have been equal to the excess of the market price of bullion above the mint price, nothing would have been gained by the melters. Had the seignorage been less than the average degradation of the coin, or 2 *per cent.*,—had it, for example, been only 1 *per cent.*, all those coins whose value was not more than 1 *per cent.* degraded below their mint standard, might have been advantageously melted; but if the seignorage had exceeded 2 *per cent.*, no coins whatever could have been melted until the degradation had increased to the same or a greater extent.

This reasoning proceeds throughout on the supposition that the coins on which a seignorage had been charged are not issued in excess. If they were, these consequences would not follow. Their too great multiplication might sink them even below their value as bullion, and occasion their immediate fusion. So long, however, as the State only coins the bullion brought to the mint by individuals, there is no risk of this happening. No one, we may depend upon it, will ever carry bullion to that establishment, and pay the expences of its coinage, unless when the coins are thereby rendered so much more valuable than the unfashioned metal.

Should the Government choose to buy bullion, and coin money on its own account, it might, by a very little attention, easily avoid all over-issue. Suppose the seignorage were 2 *per cent.*, then any given weight of coins of the mint standard ought, provided the currency be not over redundant, to purchase 2 *per cent.* more than the same weight of bullion. So long, therefore, as this proportion is preserved between coined money and bullion, it shows that the proper supply of currency has been issued. When the relative value of the coins declines below this limit, it shows that too many of them have got into circulation; and when, on the contrary, their relative value increases, it shows that the supply is too limited, and that an additional quantity may be advantageously issued.

If the supply of Coins could be sufficiently limited, a very high Seignorage might be exacted.

But it is easily seen, from the principles we have already established, that it is not at all necessary that the charge for seignorage should be limited to the mere expences of coinage. It may, without injury to any individual, be carried considerably farther. Provided the amount of the coins on which a seignorage is imposed, is limited to the precise amount of those that previously circulated in the country, its imposition to whatever height it might be carried will not affect their exchangeable value. The State being, by the supposition, in the exclusive possession of the privilege of coining, no additional supply of money could be brought to market. And supposing the business of the society to continue the same—that is, supposing the same quantity of commodities to be brought to market, and exchanged for the same quantity of coins of the same denomination, it is plainly impossible that prices could be in any way affected. Invariability of value is the great desideratum in money; and provided this is maintained, as it always may be, by properly limiting the quantity in circulation, it is of no consequence whether the weight of the coins is increased or diminished. A hat that had previously to the imposition of the seignorage sold for a guinea, would still fetch one. The guinea, it is true, would now be diminished in size; but as its value would be increased in proportion to this diminution, and as small coins are equally well adapted to serve every purpose of a circulating medium as those that are larger, the society would not suffer the smallest inconvenience from that circumstance. It is certain, indeed, that if the monopoly were not rigorously enforced, or if individuals were

permitted to issue supplies of money from private mints, free from the charge of seignorage, the increase of quantity would speedily sink the value of the whole coins in circulation to a level with the expence necessary to indemnify those who could produce them on the lowest terms; so that those on which a high seignorage had been charged, would not have any greater value than those which had been exempted from that charge. But, wherever the supply of money is limited, and competition excluded, this principle ceases to have any operation; and its value is then regulated exclusively by the proportion which the total quantity in circulation bears to the total demand. This principle is farther elucidated in a very able article on seignorage, by Mr Tooke, printed in the *Appendix* (p. 180) *to the Lords' Report of* 1819.

Difficulty of sufficiently limiting the supply of Coins, and consequent necessity of imposing only a moderate Seignorage.

It must not, however, be concealed, that if an attempt were made to charge a very high seignorage, it would be extremely difficult to limit the supply of coins. The inducement to counterfeit money would, in such circumstances, be very greatly increased, while the chances of detection would at the same time be very much diminished. It would not then be necessary, in order to derive a profit from the issue of counterfeit coins, that they should be manufactured of a baser metal. The saving of a heavy charge on account of seignorage would of itself afford a sufficient profit; and this could be derived, though the metal contained in the forged coins was of the standard purity. But, although it might, for this reason, be quite impossible to limit the supply of currency, and consequently to sustain its value, if an exorbitant seignorage were charged, the same difficulty would not stand in the way of the imposition of a moderate one. The nefarious business of counterfeiting could not be carried on if it did not yield a sufficient premium to the forgers to indemnify them for the risks and odium to which they are exposed. Now, it is plain, that if the seignorage were less than this premium, it could afford them no encouragement to the issue of counterfeit coins. And although it might be difficult to form any very precise estimate of what this premium might be, yet it is abundantly certain that it could not amount to less than from 5 to 7 *per cent.*

Amount of the Gold Coinage since the Accession of James II.

It appears from an account inserted in the appendix to the *Report* drawn up by the Lords in 1819, that new gold coins, of the value of L.74,501,586, had been issued by the mint between the 1st January 1760, and the 13th April 1819. To this sum we have to add $5\frac{1}{2}$ millions since issued, making in all an issue of about *eighty* millions of gold coins since the accession of his late Majesty. But the seignorage was remitted in the reign of Charles II.; and it appears, from the accounts published by Mr Ruding and others, that L.28,172,149 of new gold coins were issued in the period between the accession of James II. (1685) and the demise of George II.; so that, in all, upwards of 108 millions of gold coins have been coined at the expence of the State, and issued since the remission of the seignorage. We shall be considerably within the mark, if we estimate the average annual expence attending this coinage at L.12,000,* and on this supposition, it will be found, that the expence of the coinage of gold only has amounted, during the 136 years which have elapsed since the accession of James II., to L.1,632,000. But, if a low seignorage of no more than 3 or 4 *per cent.* had been charged on the gold coins, it would have produced *three* or *four* millions—a sum which might have been collected, without occasioning the least injury to any individual, and which, besides defraying the entire expences of the coinage, would have left a considerable surplus revenue.

Expence of the Coinage of Gold and Silver.

In his evidence before the Lords' Committee in 1819, Mr Mushet stated, that, with the improved machinery now in use in the mint, gold coin could be manufactured for about 10s. *per cent.* (*Minutes of Evidence*, p. 207.) And the expence of the manufacture of the silver coin may, we believe, be taken at about three times as much, or $1\frac{1}{2}$ *per cent.* In France the coinage of gold costs 0.29 *per cent.*, and of silver 1.50 *per cent.*: In Russia the gold costs 0.85, and the silver 2.95 *per cent.* (Storch, Tom. VI. p. 74.)

History of Seignorage in England.

The precise period when a seignorage first began to be charged on the English silver coins has not been ascertained. It must, however, have been very early. Mr Ruding mentions, that, in a mint account of the 6th Henry III., one of the earliest he had met with, the profit on L.3598, 0s. 4d. of silver coined at Canterbury, is stated to be L.97, 9s., being exactly 6d. a-pound, of which the King had L.60, 18s. $3\frac{1}{2}$d., and the Bishop the residue. (*Annals of the British Coinage*, Vol. I. p. 179, 4to ed.) In the 28th Edward I. the seignorage amounted to 1s. $2\frac{1}{2}$d. *per* pound, $5\frac{1}{2}$d. being allowed to the master of the mint, to indemnify him for the expences of coinage, and 9d. to the crown as its profit. Henry VI. increased the master's allowance to 10d. and 1s. 2d., and the King's to 1s. and 2s. In the reign of Edward IV. the seignorage varied from 4s. 6d. to 1s. 6d. It was reduced to 1s. in the reign of Henry VII.; but was prodigiously augmented in the reigns of his successors, Henry VIII. and Edward VI., whose wild and arbitrary measures produced, as we shall afterwards have occasion to show, the greatest derangement in the state of the currency. During the long and glorious reign of Elizabeth, the seignorage varied from 1s. 6d. to 2s. *per* pound; at which sum it continued, with very little variation, until the 18th of Charles II. (1666), when it was totally remitted.

From this period down to 1817, no seignorage was charged on the silver coin; but a new system was then adopted. The value of silver relatively to gold, having been underrated in the mint proportion of the two metals fixed in 1718, all the heavy silver coins were withdrawn from circulation, and gold only being used in all the larger payments, it became,

* Lord Liverpool states, that the entire expences of the mint, from 1777 to 1803, amounted to L.488,441, which gives an average expenditure of L.18,786 a-year. (Liverpool *on Coins*, p. 156.)

 in effect, what silver had formerly been, the standard of the currency. The act 56th Geo. III., regulating the late silver coinage, was framed so as not to interfere with this natural arrangement, and to render the new silver coins entirely subsidiary to gold. For this purpose silver is made a legal tender only to the extent of 40s.; and 66s. instead of 62s. are coined out of a pound of troy, the 4s. being retained as a seignorage, which, therefore, amounts to $6\frac{14}{31}$ *per cent.* The power to issue silver is vested exclusively in the hands of Government; who have it, therefore, in their power to avoid throwing too much of it into circulation, and consequently to prevent its fusion, until the market price of silver shall have risen to above 5s. 6d. an ounce.

This arrangement was censured by Lord Lauderdale, Mr J. P. Grant, and others, in the debates on the question of returning to cash payments in 1819. They contended that the overvaluation of silver with respect to gold would render it the interest of every debtor to discharge his debts with silver, and that the gold coins would in consequence be driven from circulation, and exported to other countries. It is plain, however, that this opinion is altogether founded in error. Debtors *cannot* discharge their debts by silver payments, for, it is only a legal tender to the extent of 40s.; and no creditor could be compelled, or would be disposed to take it in payment of a larger debt, except at its real value. *

In the 18th year of the reign of Edward III., the period when we begin to have authentic accounts of the gold coinage, a pound troy of gold bullion was coined into florins, of the value of L.15: Of this sum only L.13. 16s. 6d. were given to the person who had brought the bullion to the mint to be coined, L.1, 3s. 6d. being retained as seignorage, of which 3s. 6d. went to the Master, and L.1 to the King. But it appears, from the mint indentures, that the seignorage on the coinage of nobles for the same year only amounted to 8s. 4d. And, from this remote period to the accession of the Stuarts, with the exception of the coins issued in the 4th and 5th Edward IV. and the 34th, 36th, and 37th Henry VIII., the total charge of coining a pound weight of gold bullion seldom exceeded 7s. or 8s. money of the time. In the 2d James I., a pound weight of gold bullion was coined into L.40, 10s.; a seignorage of L.1, 10s. being deducted, 6s. 5d. of which went to the Master, and L.1, 3s. 7d. to the Crown. The seignorage on gold was remitted at the same time (18th Charles II.) with the seignorage on silver, and has not since been revived. †

As the regulation of the seignorage depended entirely on the will of the sovereigns, we cannot be surprised at the variations in its amount at different periods, or that it should have fluctuated according to their necessities and caprices. It was, indeed, hardly possible that it should have been otherwise. Our ancestors were totally ignorant of the principle, by a strict adherence to which the imposition of a seignorage can alone be rendered advantageous. They considered it as a tax which might be increased and diminished at pleasure. And, far from taking any steps to limit the quantity of coin in circulation, so as to maintain its value, they frequently granted, to corporate bodies, and even to individuals, ‡ the privilege of issuing coins, not subjected to this charge. No wonder, therefore, that the seignorage should have been considered as a most unjust and oppressive tax, and that its abolition should have been regarded as a very advantageous measure.

Remedy or Shere.

Besides the revenue arising from the seignorage, our kings formerly derived a small revenue from the *remedy* or *shere*. It having been found impossible to coin money to correspond in every particular, both of weight and purity, with a given standard, a small allowance has always been made, in the different mints, to the master, whose coins are held to be properly executed, provided their imperfections do not exceed this allowance, or remedy. The amount of the remedy has varied very little since the reign of Edward III.; having, during this long period, been almost always one-eighth of a *carat*, or 30 grains of pure gold *per* pound of gold bullion, and two penny weight of pure silver *per* pound of standard silver bullion. By the law of 1815, the remedy for gold coins is fixed at 12 grains *per* lb. in the weight, and one-sixteenth of a carat in the fineness. The remedy for silver continues the same as before.

It does not appear that our princes derived any considerable advantage from the *remedy* previously to the reign of Elizabeth. But she, by reducing the master's allowance for the expence of coinage from 1s. 2d. to 8d. obliged him to come as near as possible to the *lowest* limit allowed by the remedy. Had the coins been delivered to those who brought bullion to the mint by *weight*, the queen, it is plain, would have gained nothing by this device; but, in the latter part of her reign, and the first seventeen years of that of her successor, James I., they were delivered by *tale*, so that the Crown saved, in this way, whatever additional sum it might otherwise have been necessary to pay to the master, for the expences of coinage. In the great recoinage in the reign of William III., the profit arising from the remedy amounted to no more than 8s. on every hundred

* Those who wish for a farther elucidation of this subject, will do well to have recourse to Mr Mushet's evidence in the *Appendix to the Lords' Report* "*on the Expediency of the Bank's resuming Cash Payments*," where it is discussed at great length, and in the most able manner.

† In the tables annexed to this article, the reader will find a detailed account of the amount of the seignorage and its fluctuations in different periods.

‡ Ruding's *Annals of the Coinage*, Vol. I. p. 185. When the right of seignorage was abolished, there was a pension, payable out of the profits derived from it, granted under the great seal, for twenty-one years, to Dame Barbara Villiers, which the legislature ordered to be made good out of the coinage duties imposed by that act. See Ruding, *in loco citato*, and Leake's *Historical Account of English Money*, 2d ed. p. 356.

Money.

pounds weight of bullion; and the coinage is now conducted with so much precision, and the coins issued so near to their just weight, that no revenue is derived from this source.

Seignorage in France.

The continental princes have, we believe, without any exception, charged a seignorage on the coinage of money. In France, this duty had been levied at a very early period. By an ordonnance of Pepin, dated in 755, a pound of silver bullion is ordered to be coined into twenty-two pieces, of which the master of the mint was to retain *one*, and the remaining twenty-one were to be delivered to the merchant who had brought the bullion to the mint. (Le Blanc, p. 87.) There are no means of ascertaining the amount of the charge made by the successors of Pepin, on account of seignorage, until the reign of Saint Louis (1226-1270), who coined the *marc* of silver into 58 sols, while he only delivered 54 sols, 7 deniers, to the merchant; at this period, therefore, the charge on account of seignorage must have amounted to one-sixteenth of the marc, or to $6\frac{1}{4}$ *per cent.* The seignorage was subsequently increased or diminished without regard to any fixed principle. In the great recoinage in 1726, it amounted, on the gold coin, to $7\frac{6}{16}$ *per cent.*, and to $5\frac{6}{7}$ *per cent.* on the silver. In 1729, the mint price, both of gold and silver, were augmented, and the seignorage on the former reduced to $5\frac{1}{26}$ *per cent.*, and on the latter to $4\frac{1}{8}$ *per cent.* A farther reduction took place in 1755 and 1771, when the seignorage on gold was fixed at $1\frac{4}{15}$ *per cent.*, and on silver at $1\frac{7}{21}$ *per cent.* At this moment, the seignorage in France hardly covers the expence of coinage, being only about $\frac{1}{3}$ *per cent.* on gold, and $1\frac{1}{2}$ *per cent.* on silver. *

SECT. IV.—*Expence of a Currency consisting of the Precious Metals.*

Estimate of the expence of a Metallic Currency.

The imposition of a moderate seignorage has, however, but a very inconsiderable effect in reducing the expence of a currency consisting of the precious metals. This expence, which is vastly greater than is generally imagined, really consists not in the coinage, for that is comparatively trifling, but in the high value, or, which is the same thing, in the difficulty of the production of the gold and silver of which the coins are manufactured. If, for example, the currency of Great Britain amounted to 50 millions of gold sovereigns, and if the customary rate of profit were 10 *per cent.*, this currency, it is plain, could not cost less than *five* millions a-year. For, had this 50 millions not been employed as a circulating medium, it would have been invested in branches of industry, in which, besides affording employment to many thousands of individuals, it must have yielded 10 *per cent.* or five millions a-year, of net profit to its possessors. But this is not the only loss. The capital of 50 millions would not be merely withheld from the great work of production, and the country deprived of the large revenue it would have derived from its employment, but it would be perpetually diminished. The ordinary tear and wear of the coins is by no means inconsiderable; and supposing the expences of the coinage to be defrayed by a moderate seignorage, the deficiency of the weight of the old worn coins must, when they are called in to be recoined, be paid by the public. There is, besides, a constant loss from shipwrecks, fire, and other accidents. And, when due allowance is made for these different causes of waste, we do not think that it would be too much to suppose, that a country which had 50 millions of gold coins in circulation, would have annually to import the 50th part of this sum, or *one* million of coins, to maintain its currency at its proper level.

Money.

Thus it appears, that if the customary rate of profit in Great Britain were 10 *per cent.*, it would cost us *six* millions a-year to maintain 50 millions of gold coins in circulation! It is indeed true, that a reduction of the rate of profit would cause a proportionable reduction in the amount of this expence, yet as the reduced expence would still bear the same proportion to the total income of the country that the higher expence did, the real cost of the currency would not be at all diminished. The case of France furnishes a still more striking example of the heavy charges attending the general use of a metallic currency. The total amount of the gold and silver currency of that kingdom has been estimated by Necker at 2200 millions of francs, and by Peuchet at 1850 millions. (*Statistique Elementaire de la France*, p. 473.) Now, supposing the lowest estimate to be the most correct, and taking the rate of profit at only *eight per cent.*, this currency must cost France 148 millions of francs a-year, exclusive of the tear and wear, and loss of the coins, which being taken, as before, at a 50th part of the entire mass, will make the whole annual expence amount to the prodigious sum of 185 millions of francs, or to about *seven and a half millions* Sterling! This enormous expence certainly forms a very material deduction, from the advantages which have resulted from the use of a currency consisting entirely of the precious metals, and has doubtless been the chief cause why, in an advanced state of society, all civilized and highly commercial countries have endeavoured to fabricate a portion of their money of less valuable materials. Of these substitutes, paper has been by far the most generally resorted to, and is in every respect the most eligible. By using paper instead of gold, we substitute the cheapest in room of the most expensive currency; and enable the society, without loss to any individual, to exchange all the coins which the use of paper money has rendered superfluous, for raw materials, or manufactured goods, by the use of which both its wealth and its enjoyments are in-

* *Administration des Finances, &c.* par Necker, Tom. III. p. 8.—Dr Smith has stated (Vol. II. p. 335), on the authority of the "*Dictionnaire des Monnoies*, par Abot de Bazinghen," that the seignorage on French silver coins, in 1775, amounted to about 8 *per cent.* The error of Bazinghen has been particularly pointed out by Garnier, in the Supplemental Volume (p. 234), added to his translation of the *Wealth of Nations.*

creased. Ever since the introduction of bills of exchange, almost all great commercial transactions have been adjusted by means of paper only. It has also been used to a very great extent in carrying on the ordinary business of society. And a plan has recently been suggested, the adoption of which would render it a very easy matter to substitute a paper for a metallic currency, and to keep its value on a par with the value of gold or silver, without making the paper exchangeable for coined money, and, consequently, without requiring the circulation of a single gold or silver coin. This is a very important discovery. *It gives us all the security of gold money, without any portion of its expence;* and the currency of any country in which it was adopted, would certainly approach very near the limits of perfection. The discussion of the principles of this plan is perhaps the most important part of our subject, and will require to be treated at considerable length. *

SECT. V.—*Paper Money.—Principle on which its Value is maintained.*

Origin of Paper Money, and principle on which Banking is carried on.

In the earliest periods of society, subsequent to the invention of alphabetic characters, the pecuniary engagements of individuals would be reduced to writing. This was necessary to give security to the creditor, that he should be able to claim the full amount of his debts, and to the debtor, that he should not be liable to any overcharge; in a word, to avoid all those differences which never fail to arise where the terms of contracts are not particularly and distinctly specified. But a very short time only could elapse before individuals, who were in possession of written obligations from others, would begin to transfer them to those to whom they were indebted,—and after the advantages derivable from employing them in this way had been ascertained, it was an obvious source of emolument for individuals in whose wealth and discretion the public had confidence to issue their obligations to pay certain sums, in such a form as might fit them, to be easily applied to perform the functions of a circulating medium in the ordinary transactions of life. No one would refuse to accept the promissory note or obligation of an individual of large fortune, and of whose solvency no doubt could be entertained, in payment of any debt that might be due to him. But as full value must have been originally

* The following estimate of the value of the gold and silver coins, now current in the principal European states, will, we believe, be found to be nearly correct:

Gold and silver coins of Great Britain, as *per* estimate in next section, .	20 millions Sterling.
The value of the gold and silver currency of France has been, as we have just seen, estimated by Peuchet at 1850 millions of francs, or . . .	
The value of the gold and silver currency of Spain was, in 1782, estimated by the Minister of Finance, M. Musquiz (Bourgoing, *Modern State of Spain*, Vol. II. p. 55. *Eng. Trans.*), at 80 millions of hard piastres, or . . .	18
The value of the gold and silver money of the Austrian monarchy, in 1807, is estimated by M. Storch (*Economie Politique*, Tom. VI. p. 80), after Hassel, at only $53\frac{1}{5}$ millions of florins; but so considerable a quantity of the compulsory paper, which had banished the gold and silver money from the country, has since been suppressed, that we may reasonably suppose the value of the coins now current in the Austrian monarchy to be doubled since that period, or to amount at present to 106 millions of florins, or	11
The gold and silver coins of the Prussian monarchy were estimated by Professor Krug (Storch, *ubi supra*), in 1805, at 60 millions of crowns, or .	
And the gold and silver coins of Russia were estimated by M. Storch (*id.*), in 1815, at 45 millions of roubles, or	
	139

We regret we have no means of forming any tolerably correct estimate of the value of the gold and silver currency of Portugal, Italy, Switzerland, Germany, Belgium, Denmark, Sweden, and Turkey in Europe. It is most probable, however, that we shall be within the mark, if we estimate it at two-thirds of the value of the coins in circulation in the other countries, or at $92\frac{2}{3}$ millions, which would give $231\frac{2}{3}$ millions as the value of the aggregate currency of Europe. The expence of this currency, supposing profits to be 10 *per cent.* and one-fiftieth to be annually wasted, would rather exceed 27 millions a-year!

The value of the gold and silver annually dug from the mines of the Old and New World has been estimated (*Bullion Report, Appendix of Accounts*, No. 33) at $45\frac{1}{2}$ millions of dollars, or L.10,237,500. We subjoin the general results of this estimation.

	Dollars.
Value of gold and silver annually brought into circulation,	45,762,803
From the Old World, ...	5,049,408
From the New World, ...	40,713,395
From Spanish America, ...	36,196,736
From Portuguese America, ...	4,439,040

given for the promissory note, it is clear that while its continuance in circulation could be no loss to the public, it would be a very great source of profit to the issuer. Suppose, for example, that a merchant issues a promissory note for L.10,000, he must, previously to his putting it in circulation, either have received an equivalent sum of ready money, or of some sort of commodities possessed of real value, or, which is the most common case, he must have advanced it to an individual who had given him security for its repayment, with interest. In point of fact, therefore, the issuer has exchanged his *promise to pay* L.10,000 for the profits to be derived from the employment of a real capital of L.10,000; and so long as the promissory note, the intrinsic worth of which cannot well exceed a sixpence, remains in circulation, he will, supposing profits to be 10 *per cent.*, receive from it a revenue of L.1000 a-year. It is on this principle that the business of banking is conducted. A banker could make no profit if he were obliged to keep as much dead stock in his coffers as was equal to the amount of his notes in circulation. But if he is in good credit, a fourth or a fifth part of this sum will perhaps be sufficient; and his profits, after the expences of the establishment, and of the manufacture of his notes, are deducted, will be measured by the *excess* of the profit derived from the notes he has in circulation, over that of the profit he might have realised by the employment of the stock he is obliged to keep in his coffers to meet the demands of the public. "A bank would never be established, if it obtained no other profits but those derived from the employment of its own capital: its real advantage commences only when it employs the capital of others." (*Proposals for an Economical and Secure Currency*, p. 87.)

Limitation of supply sufficient to sustain the value of Bank Paper.

As no means have been devised to limit the supply of the promissory notes issued by private individuals, their value, it is plain, could not be maintained if those by whom they were issued fell into discredit, or if they were relieved from their promise to pay them. But it is otherwise with the promissory notes issued by the state, or by an exclusive company acting under its control. The quantity of such notes may be effectually limited; and we have shown that, when this is the case, intrinsic worth is not necessary to a currency, and that, by properly regulating the supply of paper money which has been declared to be a legal tender in all payments, its value may be sustained on a par with the value of gold, or of any other commodity. It was by acting on this principle of limitation, or, which was in effect the same thing, by restricting the issues of the Bank of England, and not from any vague and confused idea that its notes would at some future and indefinite period be paid in gold, that their value was maintained in the interval between the passing of the restriction act in 1797, and the commencement of bullion payments in 1820. No rational or intelligible explanation of this circumstance—a circumstance so much at variance with all the old theories of paper money—can be deduced from any other principle. The circumstance of their being depreciated never creates any indisposition on the part of the public to apply for accommodation to a bank whose notes are a legal tender. The presenter of a bill for discount is quite indifferent whether the notes which are given to him in exchange for it are payable in specie or not. His object, in resorting to the bank, is to exchange his promissory note for money—that is, for paper that will be received in payment of his debts, or of whatever commodities he may be desirous of purchasing. It is, therefore, of no moment to him, whether those who are entrusted with the power of issuing paper, have issued so much as to depress its value relatively to gold, or whether they have restricted their issues so as to sustain its value on a level with the value of that metal. These circumstances, it is true, affect the permanent interest of every class of society, whose incomes cannot be made to vary with every variation in the value of money: but, in as much as the money prices of goods rise and fall with every increase or diminution of the supply of paper, merchants, who are the principal demanders of discounts, are comparatively but little affected by its fluctuations. The merchant who presents a bill for L. 500 or L. 1000 to a bank, has acquired this bill, if it has arisen out of a real commercial transaction, in lieu of a certain quantity of goods, which, at the then value of money, were worth L. 500 or L. 1000; and it is this L. 500 or L. 1000 which, by presenting the bill to the bank, he wishes to obtain. If the value of money had been different, the price of the goods, and consequently the sum for which the bill was drawn, would also have been different. It is to this market value of money at the time that, in all commercial transactions, attention is exclusively paid. When, in 1809, 1810, 1811, 1812, 1813, and 1814, the Bank of England issued such a quantity of paper, as to depress its value from 10 to 25 *per cent.* below the value of bullion, the circumstance of an act of Parliament having declared, that its notes should be paid in cash at the restoration of peace, had as little effect in raising their value, as their depreciation had in diminishing the applicants for discounts. The truth is, that individuals never resort to a bank for a supply of paper money, unless they have immediate occasion for its services. After it has been obtained, they throw it into the market for whatever it will bring; and as they purchased it on the same terms (for it is seldom that the value of money can be materially affected in the short interval between the time that a bill is discounted and when it becomes due), they generally get as much for it, and perhaps more, than it cost. We shall immediately explain what it is which constitutes the natural limit to the applications for paper money; but we have said enough to show, that it has nothing whatever to do with the convertibility of notes into cash.

Those who have recourse to a bank to obtain discounts of accommodation bills, like the presenters of real bills, consider only the present value of money. Accommodation bills are never discounted, except with the view of immediately employing the money so obtained, either in the purchase of commodities, or of labour, or in the payment of debts: and, whether one pound notes are of the value of 10s. or 20s.

is obviously of no consequence; in as much as the amount of the bill presented for discount is regulated accordingly.

The circumstance of the circulation of country bank notes ceasing as soon as any general suspicion is entertained of the solvency of those by whom they are issued, is nowise inconsistent with this principle. Country bank notes are rendered exchangeable, at the pleasure of the holder, for Bank of England notes; but since the epoch of the restriction down to 1820, the latter not being exchangeable for any other commodity, have constituted the real standard of exchangeable value. When a country bank lost credit, the circulation of its notes was stopped, because a suspicion was entertained that it would be impossible to exchange them for paper of the Bank of England; or, in other words, for that species of paper which constituted the real medium of exchange. But, it is impossible to imagine, that the paper constituting this medium should itself be affected by a want of credit. Every individual knew that it had no intrinsic worth; and, as we have already shown, its value was regulated, and must, whenever it is not rendered exchangeable for a given quantity of some other commodity, continue to be exclusively regulated, by the amount of it in circulation compared with the demand.

It appears, therefore, that if there was perfect security, that the power of issuing paper money would not be abused; that is, if there was perfect security for its being issued in such quantities, as to preserve its value relatively to the mass of circulating commodities nearly equal, the precious metals might be entirely dispensed with, not only as a circulating medium, but also as a standard to which to refer the value of paper.

Difficulty of limiting the supply of Bank Paper, otherwise than by rendering it exchangeable for Gold or Silver.

Unfortunately, however, no such security can be given. This is a point, respecting which there can be no difference of opinion. We have it in our power to appeal to a widely extended and uniform course of experience—to the history of Great Britain, and of every other state in Europe, and to that of the United States—to show that no man, or set of men, have ever been invested with the power of making unrestricted issues of paper money without abusing it; or, which is the same thing, without issuing it in inordinate quantities. If the power of supplying the state with paper money be vested in a private banking company, such as the Bank of England; then, to suppose that they should, by limiting their issues, endeavour constantly to sustain the value of their paper, would be to suppose that they should be extremely attentive to the public interest, and extremely inattentive to their own private interest! The re-enactment of the restriction act, and the rendering of it perpetual, would not have the least effect on the value of our paper currency, provided its quantity was not at the same time increased. But that, in such circumstances, it would be increased, is abundantly certain. Such a measure would enable the Bank of England to exchange bits of engraved paper, not worth perhaps 5s. a quire, for as many, or the value of as many hundreds of thousands of pounds. And is it to be supposed, that the directors and proprietors of the bank would not avail themselves of such an opportunity to amass wealth and riches? Is it to be supposed, that if the government enables a private gentleman to exchange a bit of paper for an estate, he will be deterred from doing so by any considerations about its effect in sinking the value of the currency of the country? In Loo Choo we might perhaps meet with such a disinterested individual, but if we expect to find him in Europe, we shall assuredly be disappointed. In this quarter of the globe, we are far too eager in the pursuit of fortune to be at all affected by such scruples. It is essential, therefore, that the issuers of paper money should be placed under some check or control; and the comparative steadiness of the value of the precious metals, at once suggests that no check can be so effectual as to subject the issuers of paper money to the obligation of exchanging their notes, at the pleasure of the holder, for a *given and unvarying quantity* either of gold or silver.

Proposition maintained by those who deny that Bank Paper can be depreciate

But it has been contended, that there is a material difference between paper money issued by a government in payment of the debts it has contracted, and that which is issued by a private banking company in discount of good bills. In regard to the former, it is admitted, on all hands, that it may be issued in excess; but, in regard to the latter, it has been strenuously urged, that "notes issued only in proportion to the demand, in exchange for good and convertible securities, payable at specific periods, cannot occasion any excess in the circulation, or any depreciation." As every one of the arguments advanced by those who contend that the paper currency of Great Britain has not been depreciated since 1797 involve this principle, it will be necessary to examine it a little minutely.

Demand for Discounts depends on a comparison between the rate of Interest and the rate of Profit.

In the *first* place, it may be observed, that the demand for discounts does *not* depend on the nature of the security required for the repayment of the sums advanced by a bank, but *on the rate of interest for which these sums can be obtained, compared with the ordinary rate of profit which may be made by their employment.* If an individual can obtain L. 10,000, L. 100,000, or any greater sum, from a banker, at 4, 5, or 6 *per cent.*, and if he can realise 7, 8, or 10 *per cent.* by its employment as capital, it is evidently his interest, and it would be the interest of every other person similarly situated, to borrow to an unlimited extent. But a banking company, which was relieved of all obligation to pay its notes in cash, and which, of course, was not obliged to keep any unproductive stock or bullion in its coffers, would be able to issue its notes at the lowest possible rate of interest; and the demand for its paper would, therefore, be proportionably great.

"The interest of money," says Mr Ricardo, "is not regulated by the rate at which the bank will lend, whether it be 5, 4, or 3 *per cent.*, but by the rate of profit which can be made by the employment of capital, and which is totally independent of the quantity or of the value of money. Whether the bank lent one million, ten millions, or a hundred millions, they would not permanently alter the market rate of interest; they would alter only the value of the mo-

ney which they thus issued. In one case, ten or twenty times more money might be required to carry on the same business than what might be required in the other. The applications to the bank for money, then, depend on the comparison between the rate of profit that may be made by the employment of it, and the rate at which they are willing to lend it. If they charge less than the market rate of interest, there is no amount of money which they might not lend; if they charge more than that rate, none but prodigals and spendthrifts would be found to borrow of them. We accordingly find, that, when the market rate of interest exceeds the rate of *5 per cent.*, at which the bank uniformly lends, the discount office is besieged with applicants for money; and, on the contrary, when the market rate is even temporarily under *5 per cent.*, the clerks of that office have no employment." (*Principles of Political Economy*, p. 511.)

From 1809 to 1815 inclusive, the period in which the value of our paper currency relatively to gold was lowest, the market rate of interest considerably exceeded the rate (*5 per cent.*) at which the Bank of England and most of the country banks invariably lend. Although, therefore, the amount of the paper currency of the country had, in that interval, been very much increased, the applicants for fresh discounts continued as numerous as ever. And there seems no reason to doubt, that, had the directors not been apprehensive, that, ultimately, they might be called upon to pay their notes in specie, the number of them in circulation would have been very much increased; at least, such would most unquestionably have been the case, had the directors acted to the full extent of their avowed opinion, that it was impossible to issue too much paper, or to reduce its value, by engrossing into the circulation such quantities as could be issued in discount of good bills. The wants of commerce are altogether insatiable. Paper money, provided the rate of interest at which bills are discounted is less than the market rate, can never be too abundant. As long as this is the case, million after million may be thrown into the market. The value of the currency may be so reduced as to require a one pound note to purchase a quartern loaf; but the circumstance of its value being diminished in proportion to the increase of its quantity, would render the demand for additional supplies as great as ever.

If the Bank of England were alone in the possession of an alchemical process, whereby guineas could be manufactured with the same facility as notes, it could not be disputed that it would then be in the power of the bank to depreciate the former value of gold, by issues of what had been produced at so very little cost. Now, in what respect would this fictitious case differ from the actual situation of the Bank of England, if the restriction act were rendered perpetual? The bank would then be enabled, without check or control, to exchange its paper for landed property, manufactured goods, government securities, &c. But we have shown, that the value of this paper, like the value of gold, in the hypothetical case, would depend entirely on the proportion which the supply bore to the demand; and, as the demand is not affected by an increase of quantity,—for that increase, by diminishing its value, renders the larger quantity of as little efficacy as the smaller quantity was before,—it is abundantly clear, that if the bank lent at a sufficiently low rate of interest, there could be no limit to its issues.

Bank of England Paper not exclusively issued in Discount of Bills.

In the *second* place, if it were true, which most certainly it is not, that the notes of a private banking company, issued in discount of good mercantile paper, could not be depreciated from excess, that will not apply to the case of the Bank of England; for, the greater part of its paper is issued in payment of the interest of the national debt, amounting to about *thirty-two* millions a-year, exclusive of the sinking fund!—and really, when such is the fact, it was a little too much to contend, as the apologists of the restriction act have almost always done, that Bank of England paper could not be depreciated; because it was only issued in discount of legitimate mercantile paper, payable sixty days after date! *

Necessity of making Bank Notes payable in Gold or Silver.

On the whole, therefore, it is plain, that whether the power of issuing paper money be vested in the hands of a private banking company, or of the government, it must be placed under some efficient check or control, such as the obligation to pay their notes in gold or silver. It is easy to discover the manner in which a check of this kind would limit the issue of paper, and sustain its value. Whenever the bank had issued so much paper as to sink its value relatively to bullion, its notes would be returned upon it, to have them exchanged for a higher value; and the bank would, in consequence, be obliged, in order to prevent the exhaustion of its coffers, to contract its issues, and thus to raise its paper to a level with gold. An extremely small profit, or an extremely small depreciation of paper, as compared with gold or silver, would be sufficient to induce the holders of bank paper to send it to be exchanged for those metals; and, hence, the value of bank notes convertible at pleasure into a *given and unvarying quantity* of gold or silver, can never differ considerably from its value. The issues of the Bank of England were for more than a century limited by the very principle, and in the very manner we have now explained, and during that whole period, they were hardly ever depreciated $\frac{1}{4}$ *per cent.*, and never more than 2 *per cent.*, and that but for a few days only.

But, although it is thus imperatively necessary, in

* Mr Baring must be excepted from this remark, for, in a debate on the 1st of May 1816, he distinctly stated in his place in the House of Commons, "that the great mass of the bank paper was issued *compulsorily* in payment of the public creditor, and in the other great transactions of government."

Estimate of the quantity of Coined Money that will be required to carry on the Circulation of the Country on the present System.

order to avoid all sudden and injurious fluctuations in the value of money, that paper money should be made exchangeable for gold or silver, it does not follow that it should be made exchangeable for gold or silver *coins*. A currency would be in its most perfect state, if it consisted wholly of paper money; but of paper money of equal value with gold or silver. It is impossible, however, to attain to this degree of perfection, so long as paper is made convertible into coin. Such convertibility renders the paper money of the same value as metallic money; but it is defective, inasmuch as it does not banish the latter from circulation, and does not, therefore, save the whole of the heavy expence of a metallic currency. The proximity of the period (7th May 1821), when the Bank of England recommenced paying in coins, has not afforded time for engrossing any considerable quantity of them into circulation. But, in 1819, Mr Baring stated, before a Committee of the House of Commons, that it was his opinion, that, in the event of the Bank of England paying their notes, at the pleasure of the holder, in a good and perfect coin, such as the sovereign, all the one pound notes would be driven from circulation, and that from 40 to 45 millions of sovereigns would ultimately be absorbed into the circulation.* But, notwithstanding the deference due to Mr Baring's authority, we have no hesitation in thinking, with the Committee, that this estimate is much too high. In corroboration of this remark, we may observe, that Messrs Whitmore (*Appendix, Bullion Report*, p. 121, 8vo ed.) and Harman (*Commons' Report*, 1819, *Minutes of Evidence*, p. 40), late Governors of the Bank of England, join in estimating the amount of the gold coins in circulation, during the three years previous to 1797, at 20 millions; and although this estimate is probably rather underrated, there are good grounds for concluding, that it is the most accurate of any that have hitherto been framed, and that it has come as near the truth as it is perhaps possible to attain in such matters.† But, whatever may have been the amount of the gold coin in circulation in 1797, there does not seem to be any good reason whatever for supposing that more of it will now be demanded: On the contrary, the extraordinary increase in the number of country banks, and the almost exclusive use of paper money for the last twenty years, must evidently form very considerable obstacles to the reintroduction of the former amount of metallic money. But, on the reasonable hypothesis, that 20 millions of coin were in circulation in 1797, and that an equal quantity will now be required for that purpose, it is plain the rendering of Bank of England notes exchangeable for coin cannot cost less than *two* millions a year! For the interest of a capital of 20 millions, including a moderate allowance for the tear and wear of the coins, would, at least, amount to 10 *per cent.*: And if Ireland were taken into account, the total annual cost of rendering the notes of the two great Banks exchangeable for coined money, could not be estimated at less than from *two and a half to three* millions.

It is in vain to contend, that the greater part of this loss must fall on the banks, and that, there-

* *Report on the Resumption of Cash Payments by the Bank, Minutes of Evidence*, p. 182.

†

There was coined in the period of the great recoinage, from 1773 to 1777, both inclusive, of gold, ...		L. 19,591,833
Remained in circulation of old guineas, of heavy and light weight, not brought in, about (Chalmers, *Comparative Estimate*, p. 350) . . .		2,000,000
There was coined in the period from 1778 to 1796, both inclusive, of gold	L. 28,863,437	
But Mr Rose states (*Brief Examination*, App. No. 4), that very near one-half of the gold, coined from 1778 to 1798, was procured from melted light guineas, &c. and therefore deducting . . .	14,000,000	
There remains sum to be added to the currency, from 1778 to 1796, both inclusive,		14,863,437
		L. 36,455,260

Now, supposing *six* millions of gold coin to have been locked up in the coffers of the Bank of England, of the country banks, and of individuals, in 1796, and estimating at other *ten* millions the quantity of guineas exported by the Government and individuals during a period of twenty years, including the greater part of the American war, and the three first years of the late war, which, considering that no seignorage is charged on the gold coin of this country, and that, therefore, it might, when melted down, be exported without any loss, is surely not a very exaggerated allowance, it results that Mr Whitmore's and Mr Harman's estimate may be justly considered as coming pretty near the truth. Had the estimate been 25 instead of 20 millions, it would, we think, have been as much above the mark, as it is now probably below it.

Mr Chalmers (*Comparative Estimate*, p. 349) estimated the aggregate amount of the gold and silver coins in circulation, in 1786, at 24 millions. Mr Rose (*Brief Examination*, App. No. 4) estimated the amount of the gold coins in circulation, in 1799, at 44 millions; and, in 1805, Lord Liverpool supposed there were 30 millions of guineas in circulation. (*Treatise on Coin*, p. 177.) It is quite unnecessary to enter into any argument, to show the gross and palpable exaggeration of the two last estimates. The author of an able critique on Lord Liverpool's work, in the 7th volume of the *Edinburgh Review*, says, "We have no desire to hazard a computation on a subject, where the data are necessarily so imperfect; but, rather than call the quantity of gold now in circulation *thirty* millions, we should be disposed to deny that it can possibly amount to *one* million!"

fore, its only effect will be to lessen the profit of these establishments. The wealth of the state is made up of the wealth of individuals; and if the bank proprietors were not obliged to employ twenty or thirty millions, or the value of twenty or thirty millions, in the purchase of gold, they would employ it in some other manner,—in the cotton or woollen manufacture, in the construction of docks, warehouses, &c. or in such a way as would be productive of wealth to themselves, and consequently to the community. It cannot be denied that the wealth of the bank proprietors is essentially national wealth; and as whatever has a tendency to increase their fortunes, without diminishing those of others, must be advantageous, the circumstance of the expence of providing a gold currency falling principally on them, ought not to be held as a valid reason for declining to adopt any expedient for diminishing that expence. Besides it is not true, that the expence of providing a gold currency would fall entirely on the bank proprietors. As the law now stands, the whole expence of coinage, amounting to about L. 15,000 a year, is paid by the state; and although a seignorage were charged to cover this expence, still, when it becomes necessary to call in the coins in circulation, the difference between the value of the old money brought to the mint to be recoined, and the coins of full weight which are given in exchange for them, has to be made up by the public.

We may, therefore, conclude, that, by continuing to act on the system now established, and obliging the Bank of England, and the Bank of Ireland, to exchange their notes for *coined* money, it will be necessary for these establishments to purchase and issue from *twenty* to *thirty* millions worth of gold coins. And the loss attending the abstraction of so great a sum from the productive industry of the country, added to the expence of mintage, and the loss that must be occasioned by the decay of the coins, ought certainly to induce us to adopt any other system, which, at the same time that it affords us equal security against fluctuations in the value of paper money, by constantly keeping it on a par with gold, would save all this expence.

Expl of Mr Ricardo's Plan for making Bank-Notes payable in Bars of Bullion,

To Mr Ricardo we are indebted for the discovery of such a system. This able Economist has shown how paper money may be kept constantly on a par with gold, without requiring the circulation of a single gold coin. His contrivance for accomplishing this desirable object is equally admirable for its simplicity and effect. It consists in making bank-notes exchangeable for bars of *assayed* bullion of the standard purity, at the mint price of L.3, 17s. 10½d. an ounce; or, which is the same thing, Mr Ricardo proposes, that for every sum of L.3, 17s. 10½d. of paper presented to the bank for payment, it should be obliged to give, *not* three guineas and 14s. 10½d., but *an ounce of standard gold bullion.*

"To secure," says Mr Ricardo, "the public against any other variations in the value of the currency than those to which the standard itself is subject, and, at the same time, to carry on the circulation with a medium the least expensive, is to attain the most perfect state to which a currency can be brought; and we should possess all those advantages by subjecting the bank to the delivery of uncoined gold or silver at the mint standard and price, in exchange for their notes, instead of the delivery of guineas; by which means paper would never fall below the value of bullion, without being followed by a restriction of its quantity. To prevent the rise of paper *above* the value of bullion, the bank should be also obliged to give their paper in exchange for standard gold at the price of L.3, 17s. * an ounce. Not to give too much trouble to the bank, the quantity of gold to be demanded in exchange for paper at the mint price of L.3, 17s. 10½d., or the quantity to be sold to the bank at L.3, 17s., should never be less than 20 ounces. In other words, the bank should be obliged to purchase any quantity of gold that was offered to them, not less than 20 ounces, at L.3, 17s. an ounce, and to sell any quantity that might be demanded, at L.3, 17s. 10½d. While they have the power of regulating the quantity of their paper, there is no possible inconvenience that could result to them from such a regulation.

"The most perfect liberty should be given, at the same time, to export or import any description of bullion. These transactions in bullion would be very few in number, if the bank regulated their loans and issues of paper by the criterion which I have so often mentioned, namely, the price of standard bullion, without attending to the absolute quantity of paper in circulation.

"The object which I have in view would be in a great measure attained, if the bank were obliged to deliver uncoined bullion in exchange for their notes at the mint price and standard; though they were not under the necessity of purchasing any quantity of bullion offered them at the prices to be fixed; for that regulation is merely suggested to prevent the value of money from varying from the value of bullion, more than the trifling difference between the prices at which the bank would buy and sell, and which would be a near approximation to that uniformity in its value which is acknowledged to be so desirable." (*Proposals for an Economical and Secure Currency*, p. 25.)

This original and well-digested scheme was first brought under the notice of the public in 1816; and its adoption as a temporary measure, to facilitate the return to payments in coin, was recommended, in 1819, by the committees of the Legislature appointed to inquire into "The Expediency of the Bank's resuming Cash Payments." In conformity with this recommendation, a bill was brought into Parliament by Mr Peel, which enacted, that, on the 1st February 1820, the Bank of England should be bound to deliver gold bullion, properly stamped and assayed, in bars of not less than 60 ounces each, in

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* "The price of L.3, 17s., here mentioned, is, of course, an arbitrary price. It might be fixed either a little higher or a little lower. In naming L.3, 17s., I wish only to elucidate the principle."

exchange for a proportionate number of its notes, when demanded, at the rate of L. 4, 1s. *per* ounce; that, on the 1st October 1820, they should be bound to deliver bullion in a similar manner, at L.3, 19s. 6d. *per* ounce; that, on the 1st May 1821, they should be bound to deliver bullion for notes at L. 3, 17s. 10½d. *per* ounce, being the standard mint price; and that this system should continue for two years more, when payments in coin were to be resumed. This last part of the arrangement has not, however, been permitted to take effect; an act having been passed last session (1820-21), enabling the bank instantly to resume cash payments of its one and two pound notes, which it has resolved to withdraw entirely from circulation; and it has since been stated by the Governor of the Bank, that the directors have commenced paying their other notes in coin, and that they are anxious to facilitate the employment of a large quantity of specie as money.*

Advantages of Mr Ricardo's Plan.

In practice Mr Ricardo's plan worked extremely well; while the over issue of paper was effectually prevented, only a very few bars were demanded from the bank, and it was generally supposed, that, instead of its operation being thus prematurely checked, it would have been rendered perpetual, and the farther circulation of gold coins prevented. Even as a device for preserving paper on a par with gold, it was, in some material respects, obviously preferable to the old method of exchanging notes for coins. When a currency consists partly of paper, and partly of the precious metals, any over issue of the former depresses, not merely the value of the paper money, but of the coins which circulate along with it. These coins are, therefore, immediately converted into bullion. Bullion, however, cannot be accumulated in any one country, without losing its relative value; and hence the ultimate effect of an over issue of bank paper, in a country whose currency partly consists of coins, is an exportation either of coin or of bullion formed out of the coin. But, on Mr Ricardo's system, as there could be no coin in circulation, there could be no employment for the melters, and no loss thereby occasioned to the state. As soon as the bullion merchants found that a profit might be made by sending notes to the bank to be exchanged for bullion, they would do so; and as the exportation of bullion is now perfectly free, it would, like sugar or coffee, be sent abroad, whenever it was more valuable there, and less valuable here, than any other commodity; that is, whenever its exportation was sure to be advantageous.

As the maintaining of paper on a par with gold, at the least possible expence to the country, and with the least inconvenience to all parties concerned, is the great object to be effected by Mr Ricardo's plan, there does not seem to be any good reason why the bank should have been obliged to give so small a quantity as sixty ounces of bullion, as fixed by the act of 1819, in exchange for a proportionable quantity of their paper. Should the plan be again adopted, it would save a great deal of trouble, or at least obviate a great deal of cavilling, were the *minimum* quantity of bullion, which could be demanded from the bank, fixed at 500 or 1000 ounces; and as, according to the plan in question, the value of paper would be prevented from falling below, or rising above, the value of gold, by the operations of respectable bullion merchants, a class of men remarkable for their shrewdness, and generally possessed of large capitals, this regulation, while it would be productive of benefit to the bank, would not, in a public point of view, be attended with any ill effects.

Though it certainly is against the interest of the directors of the bank, to reduce their paper below its proper level, still it cannot be denied, even by those who contend that they have no power indefinitely to add to their issues, that they have the power *to refuse to discount*, and that, consequently, they have it in their power to reduce the currency to the narrowest limits. Such a power ought not to be entrusted to the state itself, and still less to the managers of a private banking company; for there can be no security for uniformity in the value of the currency, when its augmentation or diminution depends solely on the will of the issuers. But, under the operation of Mr Ricardo's system, the bank would not only be prevented from reducing the value of its notes below the value of bullion, but it would also be prevented from raising them above its value. Should the directors capriciously limit the quantity of its paper, they would raise its value; and bullion would forthwith be carried to the bank, and exchanged for notes, at the rate of L.3, 17s., or of L.3, 17s. 6d. an ounce. The *minimum* quantity of bullion to be offered to the bank in exchange for its paper, ought also, in order to save trouble, to be limited to 500 or 1000 ounces. And, as it is the interest of the bank to furnish the circulation with such a quantity of paper as would keep its value from rising above the value of bullion, it could not complain of being subjected to a restraint which would never be felt except when its issues had been improperly reduced.

With a paper currency convertible into bullion the bank would, in a great measure, be secured against the ill effects of any sudden panic amongst the holders of its notes. Panics generally operate with the greatest effect on the lower classes, or on the holders of small notes; and it is they that, on such occasions, press to the bank to demand payment. Extensive merchants and money-dealers are aware that no bank, however wealthy, could retire all its notes in the short space of eight or ten days; and they are also aware that the maintenance of their own credit is intimately connected with the prosperity of the bank. But such considerations do not influence the holders of small notes; and accordingly we find that the drain upon the bank, in 1783, and the crisis of 1797, were chiefly brought about by the prevalence of a panic among the retail traders and small farmers. But, to such persons, a bar of gold

* *Governor's Speech at a Court of Bank Proprietors,* 20th September 1821.

could be of very little service; and, even if it were, by fixing the *minimum* quantity of bullion to be given by the bank in exchange for its notes at 500 or 1000 ounces, it would not be possible for them to make any sudden run. Before sending notes to be exchanged, they would have to concert measures, to join together, and to make a demand in common. A considerable time being thus necessarily expended in the adjustment of the preliminary steps of the business, the bank would be enabled to make the necessary preparations to meet the run; and, what is of still more consequence, since the panic could not operate immediately, it is probable, that, by the time preparations had been made for demanding payment from the bank, it might have altogether subsided. This certainly forms a very strong recommendation of the plan in question; and it is one which was not originally in the contemplation of Mr Ricardo.

By lessening the danger to be apprehended from sudden runs, and by preventing all demand for bullion, for the purpose of internal circulation, except as small change, this plan would enable the bank to carry on business with a comparatively small supply of bullion in its coffers. In ordinary cases, indeed, no bullion would ever be demanded, except when the directors had fairly overstepped the proper limit in issuing; and the country would not only be benefited by the profitable employment of the capital, which would otherwise be invested in coin, but it would also be benefited by the profitable employment of the greater part of that capital, which, previously to the restriction, was locked up in the coffers of the bank.

The circumstance of no alteration being required in the law relating to country banks, is also a considerable recommendation in favour of Mr Ricardo's plan. It would be enough that these should then, as now, be required to pay their notes, when demanded, in Bank of England notes, or in the legal currency of the country. If the value of the latter is sustained, it is impossible that the interchangeable paper of the country banks can ever be depreciated from over issue.

It appears, therefore, as well from reasoning as from experience, that, by the adoption of this plan of making notes payable in bullion, we should have all the security against fluctuation in the value of the currency that we possess under our present system; while we should possess this security, without incurring any part of the expence of a gold or silver currency; except what might be required for small payments below the value of *one pound*, thereby effecting a saving, which, on account of the united kingdom, cannot be estimated at less than *two and a half or three millions a year*. And it further appears, that the security of the bank against the pernicious effects of sudden panics among the holders of its notes would be greatly increased by its adoption, and that the banking business might henceforth be carried on with a much less amount of unproductive capital.

Its supposed tendency to perpetuate the Crime of Forgery; reason why Mr Ricardo's Plan has been abandoned.

The unprecedented and alarming increase of the crime of forgery,—a crime which was scarcely known in this country previously to the restriction act, *—and the general belief that it could not be prevented otherwise than by the suppression of the smaller notes of the Bank of England, appears to have been the sole reason why a plan, which promised to be productive of so many advantages, has been abandoned, and the country again subjected to the heavy expence of a metallic currency; nor, provided this had really been the only means by which so desirable an object as the prevention of forgery could be effected, should this sacrifice have been deemed too great. We are satisfied, however, that such is not the case; and that it is not to the increased issue of Bank of England notes, but to their shamefully defective execution, that the prevalence of forgery ought principally to be ascribed. It is now nearly twenty-five years since Bank of England paper has constituted the legal currency of the country, and during the whole of that period, and for many years previously, there has been *no visible improvement in its manufacture*. Apparently satisfied with the security derived from *private* marks, the directors have continued to issue notes, engraved in so wretched a style, and which afford so few distinguishing peculiarities, or points, on which the eye can rest when comparing them with each other, that they almost seem to have been intended to stimulate the efforts of forgers! But, although no improvement has been made for nearly half a century in the manufacture of the notes of the Bank of England; and although they are executed in so rude and clumsy a manner, as to be easily imitated by every engraver's apprentice, it would be rather rash to conclude from thence that the arts have all the while been stationary, and that it is impossible to render their imitation a work of comparative difficulty! It is, we admit, no easy task to manufacture a note which may not be counterfeited, even by ordinary engravers, with sufficient exactness to deceive the mass of those into whose hands it might be supposed to come in the course of circulation. But, that this is not an insurmountable difficulty is certain. The experience, both of Ireland and the United States, shows that notes may be engraved in such a manner, as to exclude all dangerous competition on the part of forgers. Previously to 1814, the period when the Directors of the Bank of Ireland adopted Mr Oldham's plan for engraving their notes, their forgery was carried on to a very great extent. But, since then, it has almost entirely ceased; and it appears from a paper printed last session (1821), by

Increase of Forgery shown to be a consequence of the defective execution of Bank of England Notes.

* It appears, from returns made to an order of the House of Commons, that, in the *eight* years previous to the restriction, *no individual was capitally convicted of forgery*, while, in the succeeding *eight* years, *one hundred and forty six individuals were capitally convicted and executed!* Only four prosecutions for forgery were instituted by the Bank of England from 1783 to 1797: In the equal period, from 1797 to 1811, they instituted 469 prosecutions! And this frightful progression has since increased even more rapidly.

Money.

order of the House of Commons, that only *seventeen* persons had been convicted of issuing forged notes in Ireland in the *three* years ending with 1820. "In Dublin, where forgeries prevailed to the greatest extent, they have been for a long time comparatively banished. It may indeed be affirmed that there are no forged notes in circulation. Occasionally attempts are made to issue them, but they are immediately detected. Scarcely a single forged note has, during the last three years, found its way to the bank."* The improvement of the engraving of the American notes has had precisely the same effects. Although, therefore, we do not pretend to be acquainted with the nature of the obstacles which have hitherto prevented the Directors of the Bank of England from issuing the improved notes, of which so much has been said, there are certainly very strong reasons for doubting whether they can be so formidable as has been represented. It is a very mistaken notion to suppose, as the Directors of the Bank of England seem to have done, that nothing less than the issue of *inimitable* notes can be of any real service. This is a degree of perfection to which it is in vain to expect to attain. Whatever has been executed by one set of artists, *may* be imitated by some other set. But, provided this imitation be rendered, as it may be, a work of very great difficulty, the public interests will be sufficiently protected. Notes, which can only be counterfeited by the best engravers, will very rarely be counterfeited at all, and never in such numbers as to be productive of any seriously injurious consequences. First rate talent is seldom, or never, found among forgers. It is by the inferior class of artists that the practice of counterfeiting has been principally carried on. Artists of superior genius, and of superior skill in their profession, have higher objects in view; and only a very small proportion of those who have the prospect of rising to distinction, by the fair and honourable exercise of their talents, will be found profligate enough to prostitute them for the sake of defrauding their fellow citizens. But, not to insist on this point, it is plain that what *has been done* in Dublin and New York, may be done in London. And although the Directors of the Bank of England cannot justly be blamed for not having produced inimitable notes; it is not easy to see how they can be vindicated from the charge of culpable negligence, and inattention to the interests of the public, in having persisted for so long a period, and after so many improvements had been effected, in issuing notes executed in so slovenly a manner, as really to act as a species of premium on forgery.

But, even if it could be shown that the suppression of the smaller Bank of England notes was the only way by which an effectual check could be given to the crime of forgery, it may be fairly doubted, whether this advantage would not be more than compensated by the increased facilities that would, in consequence, be given to the issuers of base coins. Forgery, it must be remembered, is an evil inseparable from the use of money—an abatement from the innumerable advantages of which it has been productive. Whatever commodity may be adopted as a circulating medium, it must, in the nature of things, be a hopeless task to attempt completely to guard against the efforts of the issuers of spurious money. If the currency consists of paper, it will be counterfeited, and if it consists of the precious metals, they will be adulterated and debased.† All that can be done, is to throw obstacles in the way of forgery—to render it, if possible, a work of extreme difficulty; and there is no good reason for supposing that it would be more difficult to do this with notes than with coins. Indeed, the very contrary seems to be established. No scheme for the improvement of the coinage has had the same success in preventing the issue of spurious coins, that Mr Oldham's inventions have had in preventing the issue of forged notes. In reasoning on this subject, we have been led into error by referring exclusively to the paper of the Bank of England. But the difficulties opposed to the issue of forged paper must be estimated by the success which forgers have had in imitating the *best*, and not the *worst*, notes in circulation. And if we refer to this proper criterion—if, for example, we take the improved notes of the Bank of Ireland, instead of the *unimproved* notes of the Bank of England, as a standard, it will be found that the security of the public against fraud and imposition is any thing but impaired by the issue of paper.

We do not, therefore, think that the plea of its being necessary to the prevention of forgery, forms any valid reason for the adoption of the measure now in progress for withdrawing the smaller notes of the Bank of England, and reverting to specie payments. To counterfeit a guinea is as great a crime as to counterfeit a guinea note; and the withdrawing of one species of money, without taking any steps to guard against the forgery of that by which it is to be supplied, merely gives a different, and, perhaps, a more profitable direction to the perverse ingenuity of those who exist only by the plunder of the public. The prevention of forgery might have been better accomplished by obliging the Bank of England to improve the fabric of its notes. And had this been done, the country would have saved an unprofitable and useless expenditure of *two millions and a half, or three millions a-year*.

Profit that ought to accrue to Public the event Mr Ricardo's Plan being adopted.

Should the plan for sustaining the value of paper money, suggested by Mr Ricardo, be again adopted, it would be expedient that steps should be taken for enabling the public to participate in the profits made by the Bank of England. In a general point of view, it is, indeed, of no importance whether the paper declared by Government to be a legal tender, and made exchangeable for bullion, is issued by the State, or on account of a private bank-

* Williams *On the Increase of Forgery on the Bank of England*, &c., p. 83.

† Notwithstanding the diminution of coined money during the restriction, the convictions for false coining increased from 380 in the seven years preceding 1797, to 558 in the seven years following that epoch.

ing company. In either case, the country will be benefited by the substitution of a cheap for an expensive species of money, and its productive capital will be increased by the whole amount of the sums that would otherwise have been employed in the effecting of exchanges. But although the *national* wealth would be equally increased, whether the power to issue paper were placed in the hands of the Government or of a private company, it is plain the wealth of individuals would be very differently affected by each of these measures. By declaring Bank of England notes to be a legal tender, and by obliging the Bank to give bars of bullion to those only who made a demand for L.1000 or L.2000, it is nearly certain that the Bank would be able to keep 25 millions of notes afloat with not more than one or two millions of bullion in its coffers as dead stock. But supposing that the stock of bullion amounted to five millions, and deducting this sum from the Bank's issues, there would remain a sum of 20 millions, which, supposing them to be lent at 5 *per cent.*, the rate at which the Bank uniformly lend, would yield *one* million a-year. And if, from this sum, we deduct the expences of the establishment, which, on the highest estimate, cannot be taken at more than L.150,000 a-year, there would remain a clear *surplus profit of L.850,000 a-year*. Now, admitting that this immense sum might be as profitably and as prudently expended by the bank proprietors as it could be by any other class of individuals, yet there can be no possible reason why the government should gratuitously concede to any private company privileges calculated to enable them to realise such prodigious gains. In any circumstances, such a proceeding would evince a very culpable inattention to the interests of the public, and, in the present financial situation of the country, would be a degree of wanton and unjustifiable profusion which could not be tolerated. If, therefore, Mr Ricardo's plan were to be carried into effect, the public ought, undoubtedly, to be permitted to share in the profits of the bank. And, besides the advantages to be derived from the adoption of the plan in disengaging a large capital from a comparatively unproductive employment, it would have the additional advantage of yielding a considerable revenue—L.500,000 a-year perhaps—to the public treasury.

Necessity of a Legislative Enactment to prevent the Circulation of Country Bank-Notes of a Lower Value than the Notes of the Bank of England.

Whether, however, the measure now in progress for withdrawing the smaller notes of the Bank of England, and supplying their place with gold coins, should be persevered in, or whether the plan which we have endeavoured to elucidate and explain should be adopted in its stead, it appears to be equally necessary to prohibit the issue of local notes of a less value than the lowest notes issued by the Bank of England. *Uniformity of value, and security against sudden and dangerous fluctuations*, are the great requisites in a currency; and they can never be more than imperfectly attained, while the country banks are permitted to issue notes of a lower value than the metropolitan bank. It is true, that, so long as the obligation to give gold coin or Bank of England notes in exchange for country notes is enforced, the latter cannot be permanently, nor even for any considerable period, depreciated from over issue. The circulation of depreciated country notes is not, however, the danger that ought to be chiefly guarded against. The great risk incurred by the holders of such notes does not consist so much in the chance of their value falling two, three, four, &c. *per cent.* below the value of the standard, as in the chance of their *losing their value altogether*, and becoming perfectly worthless.

From the principle on which the banking business is conducted, that is, from the circumstance of the profits of a banking company depending mainly on the excess of the value of their notes in circulation above the value of the dead stock retained in their coffers to meet the demands of the public, it is obvious, that no company, however wealthy, and however well their affairs may be managed, can avoid being considerably distressed and embarrassed by sudden runs, or demands for payment of their notes. But panics, which are the great cause of runs, seldom or never become general, except when the banks issue notes of so low a value as to fit them for being used in retail trade, and in the ordinary business of society. Previously to 1797, neither the Bank of England, nor any of the English country banks, were permitted to issue notes for less than *five* pounds. The currency used in small payments was thus made to consist exclusively of the precious metals; and as there was no opportunity for a panic taking place among the holders of small notes, only very few runs were made on the banks, and very little loss was sustained by their failure. In 1797 this system was changed, The Bank of England was then, for the first time, empowered to issue one and two pound notes, a privilege which was soon after granted to the country banks. Bank paper having, in consequence of this arrangement, and of the restriction on cash payments, become the only currency of the country, and being in the hands of almost every individual, the chances of runs, and, what is more to the purpose, runs themselves, were multiplied to an unprecedented extent. Every subsequent period of considerable commercial distress has been marked by the ruin of several country banks; and in some districts these establishments have been almost entirely swept away, and the inhabitants involved in a degree of misery and suffering of which no adequate idea could have been previously formed.

Failure of the Country Banks in 1814, 15, and 16.

From an account in the *Appendix* to the *Lords' Report*, "*On the Resumption of Cash Payments by the Bank*," it appears, that, in the period from 1797 to 1818, 230 commissions of bankruptcy had been issued against country bankers in England and Wales. Of these the far greater proportion were issued in 1814, 1815, and 1816. In 1814, 29 banks failed, out of 699 that were then in existence; in 1815, 26 failed out of 543; and, in 1816, 37 out of 585: so that, in the short space of *three* years, NINETY-TWO country banks, or *one* out of every *seven and a half* of the total number of these establishments, existing in 1814, became bankrupt, besides a much greater number that stopped payment, for a longer or shorter period. Nor did the mischief cease here. The currency was not only diminished by the sudden withdrawing of the notes of the insolvent banks, but the issues of all

Money. the rest were very greatly contracted. The Board of Agriculture estimated, that, in the county of Lincoln only, above three millions of country bank paper had, in the course of eighteen months, been withdrawn from circulation. And, in a variety of other extensive districts in England, and in the south of Ireland, no money was to be found in circulation,—credit was totally annihilated; and so great was the panic, that even the notes of the Bank of England would hardly pass current, except at a discount. These failures were the more distressing and calamitous, as they chiefly affected the industrious classes, and frequently swallowed up in an instant the fruits of a long life of unremitting and laborious exertion. That support, on which too many of the agriculturists and manufacturers rested, gave way at the moment when it was most necessary. Prices instantly fell; and thousands, who, but a moment before, considered themselves affluent, found they were destitute of all real property, and sunk, as if by enchantment, and without any fault of their own, into the abyss of poverty. The late Mr Horner, the accuracy and extent of whose information on such subjects cannot be called in question, stated, in his place in the House of Commons, that the destruction of English country bank paper in 1814 and 1815 had "given rise to a universality of wretchedness and misery, which had never been equalled, except, perhaps, by the breaking up of the Mississippi scheme in France!*

It is certain, however, that if the country banks are still permitted to continue their issue of small notes, their liability to runs will, in future, be very much increased. From 1797, down to last year, the notes of the Bank of England, for which the country notes were made exchangeable, were *not* convertible into gold or silver; and those who then made a run on a country bank merely got one species of paper in exchange for another. It is obvious, that this circumstance must have operated in a very powerful manner, to diminish the tendency among the poorer classes to runs. But, now that the Bank of England has ceased issuing small notes, and begun paying its large notes in cash, the country bankers will be obliged to give cash for their small notes; and there can be no doubt, that, in all periods of difficulty and alarm, many who would never have thought of making a demand on them for Bank of England notes, will be disposed to make such a demand for coins. Money.

In order to diminish the chances of runs arising from the new position in which the country banks are now placed, the directors of several of these establishments have adopted the ingenious device of making their notes payable in London, and *not* in the place where they are issued! This is a good deal similar to the clause that was formerly inserted in the notes issued by some of the Scots banks, which made it *optional* for them either to pay the bearer when the note was presented, or *six months* after such presentment, allowing legal interest for these six months. The effects of this clause, which was abolished by act of Parliament, in degrading the value of the Scots notes, are detailed by Dr Smith; and there can be no question that the clause inserted in the English notes will have similar effects. A note, which cannot be converted into cash, unless it is carried two or three hundred miles, perhaps, from the sphere of its circulation, is plainly not so valuable as a note payable at the place where it is issued; and if the Legislature do not interfere to check this practice, we shall certainly have as many different values of paper, as there are different distances between the principal country towns and London! An abuse of this kind cannot be tolerated.

It appears, therefore, that, to give uniformity to the value of the currency, and as far as possible to guard the public against the risk of sudden and injurious fluctuations in the value of money, the circulation of all local notes, for a smaller sum than the lowest notes issued by the Bank of England, should be prohibited. It is in vain to urge the respectability and the wealth of the individuals engaged in the banking business, in opposition to this regulation.

* The number of country banks in England and Wales, to which licences had been granted to issue promissory notes, in 1797, is not exactly known. They are stated by Mr Thornton, in his *Essay on Paper Credit* (p. 154), to have amounted to 350; but other accounts reduce this number to 230.—(*Appendix Bullion Report*, p. 213, 8vo. ed.) They have since been prodigiously multiplied. We subjoin an account of their number, of the number of their partners, and of the number of the commissions of bankruptcy issued against them from 1808 to 1818, both inclusive.—(See *Appendix Lords' Report*, 1819, pp. 416, 426.)

Years.	Number of Banks.	Number of Partners.	Commissions of Bankruptcy.	Years.	Number of Banks.	Number of Partners.	Commissions of Bankruptcy.
1808	755	2,255	5	1814	699	2,145	29
1809	783	2,372	7	1815	643	1,956	26
1810	741	2,278	26	1816	585	1,791	37
1811	739	2,277	4	1817	576	1,751	5
1812	761	2,350	17	1818	587	1,776	6
1813	733	2,234	8				

There were thirty banking companies in Scotland, in 1818, possessed of licences to issue promissory notes; which, in addition to their head offices, had ninety-eight subordinate offices, or agencies, in different parts of the country.

Money.

This consideration might have been equally urged previously to the failures in 1814, 1815, and 1816; and, as we have already shown, no bank can be secure against runs, and consequently against embarrassments, if it issues notes of a low value. Neither can it be justly objected that this measure would interfere with the freedom of industry. It is admitted on all hands, that, in order to prevent the confusion that would arise from the currency of coins of different values, but of the same denomination, it is expedient the government should interfere to prohibit the circulation of private tokens, and of all coins which are not struck at the public mint, and which are not of a certain weight and purity. But, if this regulation be expedient, why should it not also be expedient to set limits to the values for which bank-notes shall be issued? The issue of low notes, by private banking companies, has, both in this country and in America, been productive of the greatest mischiefs; and the government is not only warranted, but it is their duty, and they are called upon to adopt such regulations as may be necessary to prevent a repetition of the calamities we have so lately experienced. Women, mechanics, and labourers of all descriptions—persons who are nowise qualified to judge of the comparative stability of banking companies, are all dealers in money; and they have a right to expect protection from such an obvious cause of loss as the granting of permission to every individual to undertake, without restraint or limitation of any kind, to supply the currency destined to carry on the ordinary business of the country.

If Mr Ricardo's plan were adopted, and bank-notes made exchangeable for bullion, and not for coins, it would be still more desirable that all country notes for less than five pounds should be prohibited, and their place exclusively supplied with Bank of England small notes. This would greatly diminish the chances of runs on the country banks; while it would, at the same time, give a uniformity of value, and a degree of cheapness and security, to the currency, to which it is, we apprehend, almost visionary to expect that it should otherwise attain.

As a farther means of increasing the respectability, and of adding to the stability of the country banks, the act of 1708, prohibiting more than *six* persons from entering into any association, or copartnery, for carrying on the trade of private bankers in England and Wales, ought to be repealed. It is, indeed, astonishing how so oppressive and so absurd a regulation should have been so long permitted to disgrace the Statute Book. We are inclined to think, that the superior wealth and solidity of the Scots banks, is in no inconsiderable degree owing to their being exempted from the operation of this regulation.

SECT. V.—*Whether Gold or Silver ought to be adopted as the Standard of the Currency, or whether it ought to consist of both.*

Impossibility of arbitrarily fixing the relative Value of Gold and Silver.

As the value of gold and silver, or the cost of their production, is perpetually varying, not only relatively to other commodities, but also relatively to each other, it is impossible arbitrarily to fix their relative value. Gold may now, or at any given period, be to silver as 14 or 15 is to 1; but were guineas and shillings coined in that proportion, the discovery of either a gold or silver mine of more than the ordinary degree of productiveness, or the discovery of any abridged process, by which labour might be saved in the production of one of the metals, would derange this proportion. As soon, however, as the mint proportion between the different metals ceases to be the same with that which they bear to each other in the market, then it becomes the obvious interest of every debtor to pay his debts in the metal whose mint valuation is highest.

Overvaluation of Gold at the Mint the cause of its being used in all considerable Payments in this Country.

In 1718, in pursuance of the advice of Sir Isaac Newton, the value of the guinea was reduced from twenty-one shillings and sixpence to twenty-one shillings; the value of fine gold to fine silver being then rated, in our mint, at $15\frac{285}{1364}$ to 1. But, notwithstanding this reduction, the guinea was still rated at a higher value, compared with silver, than it ought to have been. This over-valuation is estimated, by the late Lord Liverpool, to have been, at the time, equal to fourpence on the guinea, or to $1\frac{19}{31}$ *per cent.*; and, as the real value of silver relatively to gold continued to increase during the greater part of last century, this difference, which, even in the reign of George I., caused all considerable payments to be made in gold, became afterwards much greater. This error in the mint valuation of silver and gold was the cause that, during the long period from 1718 down to the late recoinage, no silver currency, of the legal weight and fineness, would remain in circulation. The real value of silver coins, relatively to gold coins, which were, equally with the former, made a legal tender by the proclamation of 1718, being underrated, they were no sooner issued than they found their way to the melting-pot. None, therefore, but very light coins remained in circulation; and when, in 1797, the further coinage of silver was forbidden, the silver currency was very much debased. But, as this currency existed only in a *limited quantity*, it did not, according to the principle already explained, sink in its current value. Though so debased, it was still the interest of debtors to pay in the gold coin. If, indeed, the quantity of this debased silver coin had been very great, or if the mint had issued such debased pieces, it might have been the interest of debtors to pay in this debased money. But its quantity being limited, it sustained its value; and gold, therefore, was in practice the real standard of the currency.

The act of 1774, declaring that silver should not be a legal tender for any debt exceeding L.25, *unless by weight according to the mint standard*, had not, as has been supposed, any effect in causing the general employment of gold as money, in preference to silver. For, to use the words of Mr Ricardo, "this law did not prevent any debtor from paying any debt, however large its amount, in silver currency fresh from the mint. That the debtor did not pay in this metal was not a matter of chance, nor a matter of compulsion, but wholly the effect of choice. It did not suit him to take silver to the mint, but it did suit him to take gold hither. It is probable that if the quantity of this debased silver in circulation had been enormously great, and also a legal tender, that

Money.

a guinea would have been, as in the reign of William III., worth 30 shillings; but it would have been the debased shilling that had fallen in value, and not the guinea that had risen." (*Principles of Political Economy*, &c. p. 520.)

Contrary effect produced by the over-valuation of Silver in the French mint.

In France a different valuation of the precious metals has had a different effect. The louis d'or which, previously to the recoinage in 1785, was rated in the mint valuation at 24 livres, was really worth 25 liv. 10 sols. Those, therefore, who chose to discharge the obligations they had contracted, by payments of gold coin in preference to silver, plainly lost 1 liv. 10 sols on every sum of 24 livres! The consequence was, that very few such payments were made, that gold was almost entirely banished from circulation, and that the currency of France consisted almost exclusively of silver. (Say, Tom. I. p. 393.) In 1785, a sixteenth part was deducted from the weight of the louis d'or, and since that period the proportional value of the precious metals, as fixed in the French mint, has more nearly corresponded with the proportion they bear to each other in the market. Indeed, Mr Baring stated, in his evidence before the Committee of the House of Commons in 1819 (*Report*, p. 192), that the difference between the mint and market proportions of gold and silver at Paris in 1817 and 1818, had not exceeded from one-tenth to one-fourth *per cent.* There is, however, no reason to presume that this coincidence, which must have been in a great degree accidental, can be maintained under any arbitrary system. To ensure the indifferent use of gold and silver coins in countries where they are both a legal tender, their mint proportion would require to be every now and then adjusted, so as to correspond with their real proportion. But as this would obviously be productive of much trouble and inconvenience, the preferable plan undoubtedly is to make only one of the metals a legal tender, and to allow the relative worth of the other to be adjusted by the unrestricted competition of the sellers and the buyers.

The absurdity of employing equally two metals as a legal tender for debts, or as a standard of value, was unanswerably demonstrated by Mr Locke and Mr Harris, and has been noticed by every subsequent writer; but so slow is the progress of improvement, that it was not till 1816 that it was enacted that gold only should be a legal tender for any sum exceeding 40s.

Silver preferable to Gold as a Standard.

Whether, however, gold should have been adopted as the standard of exchangeable value, in preference to silver, is a question which is not so easy of solution, and on which there is a great diversity of opinion. Mr Locke, Mr Harris, and Mr Ricardo, are decidedly of opinion that silver is much better fitted than gold for a standard; while Dr Smith, although he has not expressed himself explicitly on the subject, appears to think that gold ought to be adopted in preference; and this opinion has been very ably supported by the late Lord Liverpool, in his valuable work *On the Coins of the Realm.*

It would be presumption in us to attempt to decide on a matter of this kind, respecting which the ablest political economists differ thus widely. We are inclined, however, to concur in opinion with those who think silver ought to be adopted as the standard. Whatever metal is set apart for this purpose, it will be a very difficult task to preserve the currency from falling into a deranged state, if it be not used in small as well as in large payments.

"The *integer*," says Mr Harris, "and its several parts, should bear an exact and due proportion of value to each other; and this would be impossible, if they were made of different materials. There must be coins of about the value of shillings and sixpences; and it would be better if we had some that were still smaller. Those sort of coins are the most frequently wanted, and there is no doing without them. But a coin of a shilling, or even of half a crown value, would be too small in gold; and, therefore, at present gold is much too valuable for a standard of money. And it would be a ridiculous and vain attempt to make a standard *integer* of gold whose parts should be of silver; or to make a motley standard, part gold and part silver."—(Harris *On Coins*, Part I. p. 60.)

Silver is, besides, as steady in its value as gold. Almost all foreign countries have adopted it as their standard; and the demand and supply is comparatively regular. The use of paper, as the principal circulating medium, entirely removes the great objection against silver—its being too bulky to be advantageously used in large payments.

A Gold and Silver Currency equally valuable.

Whether gold or silver be adopted as the standard of our currency, will not affect its total cost or value; for, the quantity of metal employed as money, or the quantity of metal for which paper is the substitute, must always be in an inverse proportion to the value or cost of that metal. If gold be continued as the standard, fourteen or fifteen times less of that metal than of silver will be required; or, what is the same thing, if the denomination of a pound were given to any *specific weight* of gold or silver, fifteen times more of such silver pounds would be required to serve as currency, or as bullion to exchange for notes—fifteen to one being about the proportion which gold bears in value to silver; and hence the expence of a currency consisting of gold coins, or of silver coins, is the same; and the expence is also the same whether the currency consists of paper convertible into gold bullion or silver bullion. But, as gold is too valuable, in proportion to its bulk, to be coined into pieces of the value of a shilling or a sixpence, and as it is desirable to have the subsidiary currency necessary in small payments, formed of the same metal as the principal currency, or as the bullion for which paper is made exchangeable, silver ought, in preference, to be adopted as the standard.

If Mr Ricardo's plan should be again adopted, and if it should be deemed inexpedient to change the standard, it would not be proper to make any alteration on the late act, allowing a seignorage of 6 *per cent.* on the silver coin; for, without some very great change in the present comparative value of gold and silver, the imposition of this seignorage will prevent all risk of the fusion or exportation of the subsidiary currency. Neither, on the supposition that silver were to be assumed as the standard, could there be any valid objection against continuing the seignorage. For, as notes would be exchangeable for bul-

lion, and not for coin, it would not cause any reduction of the standard, while it would have the beneficial effect of preventing the too great multiplication of the subsidiary currency, and of relieving the country of the expences of coinage.

Were a seignorage charged on the gold coins, paper, it is obvious, might be depreciated to the full extent of that seignorage, before it would be the interest of the holders to demand coin for the purpose of melting it into bullion, and consequently before the check of specie payments could begin to operate. But, even with such a seignorage, the risk of paper being depreciated, might be completely avoided, by making it obligatory on the bank to pay their notes, either in *bullion*, at the mint price of L.3, 17s. 10½d. an ounce, or coin, at the pleasure of the holder. A regulation of this kind could not be justly considered as imposing any hardship on the bank; for it is plain, that no bullion would ever be demanded from it, except when, by the issue of too much paper, its value had been sunk below the standard.

Sect. VI.—*Standard of Money.—Degradation of the Standard in Italy, France, Great Britain, and other Countries.—Pernicious Effects of this Degradation.*

Standard of Money.

By the standard of money is meant the degree of the purity or fineness of the metal contained in the coins of a particular country, and the quantity or weight of such metal contained in these coins. Twelve ounces of the metal, of which standard English silver coins are made, contains 11 ounces 2 dwts. fine, and 18 dwts. alloy; and of a pound Troy of this standard silver, our money pound, called the pound Sterling, contains 66 shillings, or $\frac{20}{66}$ parts of $\frac{11 \cdot 1}{12}$ of a pound Troy of fine silver, that is, $1614\frac{36}{66}$ grains. From the 43d of Elizabeth down to 1816, when the act 56th Geo. III. cap. 68, imposing a seignorage of about 6 *per cent.* on the silver coin, was passed, the pound weight of standard silver bullion had been coined into 62 shillings. All the English silver coins have been coined out of silver of 11 oz. 2 dwts. fine, from the Conquest to this moment, except for a short period of sixteen years, from 34th Henry VIII. to the 2d Elizabeth.

Purity of English Coins.

The purity of gold is not estimated in Great Britain, and in most other European countries, by the weights commonly in use, but by an Abyssinian weight, called a *carat.** The carats are subdivided into four parts, called grains, and these again into quarters; so that a *carat grain*, with respect to the common divisions of a pound Troy, is equivalent to 2½ penny-weights. Gold of the highest degree of fineness, or pure, is said to be 24 carats fine. When gold coins were first made at the English mint, the standard of the gold put in them was of 23 carats 3½ grains fine, and ½ grain of alloy; and so it continued, without any variation, to the 18th Henry VIII., who in that year first introduced a new standard of gold of 22 carats fine, and 2 carats alloy. The first of these standards was called the old standard; the second was called the new standard, or crown gold, because crowns, or pieces of the value of five shillings, were first coined of this new standard. Henry VIII. made his gold coins of both these standards under different denominations; and this practice was continued by his successors until 1633. From that period to the present, the gold of which the coins of this kingdom have been made has been invariably of the *new* standard, or crown gold; though some of the coins made of the old standard previously to 1633 continued to circulate till 1732, when they were forbidden to be any longer current. (Liverpool *On Coins*, p. 27.)

Weight of English Coins.

The standard of our present gold coins is, therefore, 11 parts of fine gold, and 1 part of alloy. The pound Troy of such standard gold is divided into 44½ guineas, each of which ought, consequently, when fresh from the mint, to weigh $\frac{1}{44\frac{1}{2}}$ of 12 ounces, or 5 dwts. $9\frac{39}{89}$ grains. The sovereign, or twenty shilling piece, weighs 5 dwts. $3\frac{171}{623}$ grains of standard gold, or 4 dwts. $17\frac{18}{11214}$ grains of pure gold.

The alloy in coins is reckoned of no value. It is allowed, in order to save the trouble and expence that would be incurred in refining the metals, so as to bring them to the highest degree of purity; and because, when its quantity is small, it has a tendency to render the coins harder, and less liable to be worn or rubbed. If the quantity of alloy were considerable, it would lessen the splendour and the ductility of the precious metals, and would add too much to the weight of the coins.

Having thus ascertained what the standard of money really is, we shall now proceed to examine the effects produced by variations in the standard. This is, both in a practical and historical point of view, a very important inquiry.

Variations of the Standard—General Remarks.

To make any direct alteration in the terms of the contracts entered into between individuals, would be a degree of barefaced oppression, and of wanton and tyrannical interference with the rights of property, that could not be tolerated. Those, therefore, who have hitherto endeavoured to enrich one part of society, at the expence of another, have found it necessary to act with greater caution and reserve. They have been obliged to substitute artifice for open and avowed injustice. Instead of directly altering the stipulations in contracts, they have ingeniously bethought themselves of altering the *standard*, by a reference to which these stipulations had been adjusted! They have not said, in so many words, that 10 or 20 *per cent.* should be added to or deducted from the mutual debts and obligations of society, but they have really effected the same thing, by making a proportional change in the value of the currency. Men, in their bargains,

* The carat is a bean, the fruit of an Abyssinian tree, called Kuara. This bean, from the time of its being gathered, varies very little in its weight, and seems to have been, in the earliest ages, a weight for gold in Africa. In India it is used as a weight for diamonds, &c. Bruce's *Travels*, Vol. V. p. 66.

Money.

do not, as we have already shown, stipulate for *signs* or *measures of value*, but for real equivalents. Money is not merely the standard by a comparison with which the relative value of commodities is ascertained at any given period; but it is also the equivalent by the delivery of a fixed amount of which, the stipulations in almost all contracts and engagements may be discharged. It is plain, therefore, that no variation can take place in its value, without essentially affecting all these stipulations. Every addition to the value of money must make a corresponding addition to the debts of the state, and of every individual; and every diminution of its value must make a corresponding diminution of these debts. Suppose that, owing to an increased difficulty of production, or to the increase of the quantity of bullion contained in coins of the same denomination, the value of money is raised 20 *per cent.*, it is plain that 20 *per cent.* is, in consequence, added to all the various sums in which one part of society is indebted to the other part. Though the *nominal* rent of the farmer, for example, is not increased by this means, his real rent is increased: He continues to pay the same number of pounds or livres as formerly; but the pound or the livre is become more valuable, and requires the sacrifice of *one-fifth* part more of corn, of labour, or of any other commodity whose value has remained stationary, to obtain them. On the other hand, had the value of money fallen 20 *per cent.*, the advantage, it is plain, would have been all on the side of the farmer, who would have been entitled to claim a discharge from his landlord, when he had paid him only *four-fifths* of the rent he had really bargained for.

But, notwithstanding it is thus obviously necessary, in order to prevent the pernicious subversion of private fortunes, and the falsifying of all precedent contracts, that the standard of money, when once fixed, should be religiously kept sacred, there is nothing that has been so frequently changed. We do not here allude to those variations which affect the value of the material of which the standard itself is composed, and against which it is impossible to guard, but to the changes which have been made in the *quantity* of that material contained in the same nominal sum of money. In almost every country, debtors have been enriched at the expence of their creditors. The necessities, or the extravagance of governments, have forced them to borrow; and to relieve themselves of the incumbrances they had contracted, they have almost universally had recourse to the disgraceful expedient of degrading the coin; that is, of *cheating* those who had lent them money to the extent of the degradation, and of enabling every other debtor in their dominions to do the same.

The ignorance of the public in remote ages facilitated this species of fraud. Had the names of the coins been changed when the quantity of metal contained in them was diminished, there would have been no room for misapprehension. But, although the weight of the coins was undergoing perpetual, and their purity occasional reductions, their ancient denominations were almost uniformly preserved; and the people who saw the same names still remaining after the substance was diminished,—who saw coins of a certain weight and fineness circulate under the names of florins, livres, and pounds, and who saw them continue to circulate as such, after both their weight and the degree of their fineness had been lessened, began to think that they derived their value more from the *stamp* affixed to them, by authority of government, than from the quantity of the precious metals they contained. This was long a very prevalent opinion. But the rise of prices which invariably followed every reduction of the standard, and the derangement that was thereby occasioned in every pecuniary transaction, undeceived the public, and taught *them*, though it has not yet taught their rulers, the expediency of preserving the standard of money inviolate.

Manner of changing the Standard.

Before proceeding to notice the changes made in the currency of this and other countries, it may be proper to observe, that the standard is generally debased in one or other of the undermentioned ways.

1*st*, By simply altering the *denominations* of the coins, without making any alteration in their weight or purity. Thus, suppose sixpence, or as much silver as there is in sixpence, should be called a shilling, then a shilling would be two shillings, and twenty of these shillings, or ten of our present shillings, would constitute a pound sterling. This would be a reduction of 50 *per cent.* in the standard.

2*d*, The standard may be reduced, by continuing to issue coins of the same weight, but making them baser, or with less pure metal and more alloy.

3*d*, It may be reduced, by making the coins of the same degree of purity, but of diminished weight, or with less pure metal: or it may be reduced partly by one of these methods, and partly by another.

The first of these methods of degrading the standard was recommended by Mr Lowndes in 1695, and if injustice is to be done, it is certainly, on the whole, the least mischievous mode by which it can be perpetrated. It saves all the trouble and expence of a recoinage; but as it renders the fraud too obvious, it has been but seldom resorted to. In inquiries of this kind, however, it is rarely necessary to investigate the manner in which the standard has been degraded. And by its reduction or degradation, *we* uniformly mean, unless when the contrary is distinctly expressed, a diminution of the quantity of pure metal contained in coins of the *same denomination*, without regard to the particular mode in which such diminution may have been effected.

In conformity with what we have observed in the first section of this article, relative to the universality of the ancient practice of weighing the precious metals in every exchange, it is found that the coins of almost every country have the same names as the weights commonly used in them. To these weights the coins at first exactly corresponded. Thus the *talent* was a weight used in the earliest periods by the Greeks, the *as* or *pondo* by the Romans, the *livre* by the French, and the *pound* by the English and the Scotch, &c.; and the coins originally in use in Greece, Italy, France, and England, received the same denominations, and weighed precisely a talent, a pondo, a livre, and a pound. The standard has not,

however, been preserved inviolate, either in ancient or modern times. But the limits within which an article of this kind must be confined, prevents us from tracing the various changes in the money of this and other countries, with the minuteness which the importance of the subject deserves, and obliges us to notice only those that were most prominent.*

History of the Money of Rome.

ROMAN MONEY.—We learn from Pliny, that the first Roman coinage took place in the reign of Servius Tullus, that is, according to the common chronology, about 550 years before Christ. The *as* or *pondo*, of this early period, contained a Roman pound of copper, the metal then exclusively used in the Roman coinage, and was divided into twelve parts or *unciæ*. If we may rely on Pliny, this simple and natural system was maintained until 250 years before our era, or until the first Punic war, when the revenues of the state being insufficient, the government attempted to supply the deficiency, by reducing the weight of the as from 12 to 2 ounces! But it is extremely improbable, that a government, which had maintained its standard inviolate for 300 years, should have commenced the work of degradation, by at once reducing their standard to *a sixth part* of its former amount; and it is equally improbable that so sudden and excessive a reduction could have been made in the value of the current money of the state, and, consequently, in the debts due by one individual to another, without occasioning the most violent commotions. Nothing, however, is said in any ancient writer, to entitle us to infer that such commotions actually took place, and we, therefore, concur with those who think that the weight of the as had been previously reduced, and that its diminution, which, it is most probable, would be gradual and progressive, had merely been carried to the extent mentioned by Pliny during the first Punic war. In the second Punic war, or 215 years before Christ, a further degradation took place, and the weight of the as was reduced from *two* ounces to *one* ounce. And by the Papyrian law, supposed to have passed when Papyrius Turdus was Tribune of the people, or 175 years before Christ, the weight of the as was reduced to half an ounce, or to $\frac{1}{24}$ of its ancient weight, at which it continued till Pliny's time and long after.†

Weight of the As.

Proportion of Silver to Copper.

The denarius, the principal silver coin in use among the Romans, for a period of 600 years, was coined five years before the first Punic war, and was, as its name imports, rated in the mint valuation at 10 asses. Mr Greaves, whose dissertation on the denarius has been deservedly eulogised by Gibbon (*Decline and Fall*, Vol. III. p. 89), shows that the denarius weighed at first only *one-seventh* of a Roman ounce,‡ which, if Pliny's account of the period when the weight of the as was first reduced was correct, would give the value of silver to copper in the Roman mint as 840 to 1, which Mr Greaves very truly calls a "most unadvised proportion." But if we suppose, with Mr Pinkerton (*Essay on Medals*, Vol. I. p. 132, edit. 1789), that when the denarius was first issued, the as only weighed 3 ounces, the proportion of silver to copper would be as 252 to 1;—a proportion which, when the as was soon after reduced to 2 ounces, would be as 168 to 1, or about a third more than in the British mint. When, in the second Punic war, the as was reduced from 2 ounces to 1, the denarius was rated at 16 ases.

Value of the Denarius.

During his stay in Italy, Mr Greaves weighed many of the consular denarii, that is, as he explains himself, of the denarii that were struck after the second Punic war, and previously to the government of the Cæsars, and he found, by frequent and exact trials, the best and most perfect of them to weigh 62 grains English Troy weight. (Greaves' *Works*, Vol. I. p. 262.) Now, as the English shilling (new coinage) contains very nearly $87\frac{1}{4}$ grains standard silver, this would give $8\frac{1}{2}$d. for the value of the consular denarius. We should, however, fall into the grossest mistakes, if we indiscriminately converted the sums mentioned in the Latin authors by this or any other fixed proportion. It is not enough to enable us to judge of the real value of a coin, that we know its weight; we must also know the degree of its purity, or the fineness of the metal of which it is made. But Mr Greaves did not assay any of the denarii weighed

* It is impossible for us to enter in this place into any discussion relative to the value of the Grecian money. It is, however, a subject of no little interest and curiosity. M. Rome de l'Isle, in his *Traité de Metrologie*, published in 1789, has given an account of the weight, and of the degree of fineness of an immense number of attic *drachmas* and *tetradrachmas*. But he does not seem to have been more fortunate than his predecessors, in deducing the value of the *talent* from the weight of the *drachmas*. The errors and absurdities into which modern critics and commentators have fallen, in estimating the value of the sums mentioned in ancient authors, is indeed astonishing. They are ably pointed out in a short essay, *De la Monnoie des Peuples Anciens*, in the supplemental volume added by Garnier to his translation of the *Wealth of Nations*.

† "Servius rex primus signavit æs. Antea rudi usos Romæ Remeus tradit. Signatum est nota pecudum unde et pecunia appellata. * Argentum signatum est anno urbis DLXXXV. Q. Fabio Cos. quinque annos ante primum bellum Punicum. Et placuit denarius pro X. libris æris, quinarius pro quinque, sestertium pro dipondio ac semisse. Libræ autem pondus æris imminutum bello Punico primo cum impensis resp. non sufficeret, constitutumque ut asses sextentario pondere ferirentur. Ita quinque partes factæ lucri, dissolutumque æs alienum. * * Postea, Annibale urgente, Q. Fabio Maximo Dictatore, asses unciales facti: placuitque denarium XVI. assibus permutari, quinarium octonis, sestertium quaternis. Ita resp. dimidium lucrata est. Mox lege Papyria semunciales asses facti."—(Plinii, *Hist. Nat.* Lib. 33, cap. 3. Ed. Lugd. Bat. 1669.)

‡ This is indeed decisively proved by a passage in Celsus. "Sed et antea sciri volo in uncia pondus denariorum esse septem" (Cels. Lib. 15, cap. 17.)

Money. by him. And although it were true, as most probably it is, that, from the first coinage of silver in the 485th year of the city to the reign of Augustus, the weight of the denarius had remained constant at $\frac{1}{7}$th of a Roman ounce, or about 62 grains; and that, from the reign of Augustus to that of Vespasian, it only declined in weight from $\frac{1}{7}$th to $\frac{1}{8}$th of an ounce;* still it is abundantly certain that its real value had been reduced to a much greater extent. Of this fact the authority of Pliny is decisive; for he expressly states, that Livius Drusus, who was Tribune of the people in the 662d year of the city, or 177 years after the first coinage of silver, debased its purity, by allaying it with $\frac{1}{8}$th part of copper. (Lib. 33, cap. 3, previously quoted.) And in a subsequent chapter (the 9th) of the same book, he informs us that Anthony the Triumvir mixed iron with the silver of the denarius; and that, to counteract these abuses, a law was afterwards made providing for the assay of the denarii. Some idea of the extent to which the debasement of the purity of the coins had been carried, and of the disorder which had in consequence been occasioned, may be formed from the circumstance, also mentioned by Pliny, of statues being every where erected in honour of Marius Gratidianus, by whom the law for the assay had been proposed! But this law was not long respected; and many imperial denarii are now in existence, consisting of mere plated copper. (Bazinghen, *Dictionnaire de Monnoies*, Tom. II. p. 64.)

The Aureus. Gold was first coined at Rome 62 years after silver, in the 547th year of the city, and 204 years before Christ. The aureus originally weighed $\frac{1}{40}$th part of the *pondo* or Roman pound; but by successive reductions its weight was reduced, in the reign of Constantine, to only $\frac{1}{72}$d part of a pound. The purity, however, as well as the weight of the aureus was diminished. Under Alexander Severus it was alloyed with $\frac{1}{5}$th of silver. We learn from Dion Cassius, who was contemporary with Severus, that the aureus was rated at 25 denarii; a proportion which Mr Pinkerton thinks was always maintained under the Emperors. (*Essay on Medals*, Vol. I. p. 148.)

Value of the Sestertius. The want of attention to this progressive degradation has led the translators of, and commentators on, ancient writers, to the most extraordinary conclusions. The sestertius, or money *unit* of the Romans, was precisely the *fourth* part of a denarius. *Nostri autem*, says Vitruvius, lib. 3. cap. 1, *primo decem fecerunt antiquum numerum, et in denario denos æreos asses constituerunt, et ea re compositio nummi ad hodiernum diem denarii, nomen retinet; etiamque quartam ejus partem, quod efficiebatur ex duobus assibus et tertio semisse* SESTERTIUM *nominaverunt*. When, therefore, the denarius was worth $8\frac{1}{2}$d., the sesterce must have been worth $2\frac{1}{8}$d. But the sestertius being thus plainly a multiple of, and bearing a fixed and determined proportion to the denarius, and consequently to the as, the aureus, and the other coins generally in use, it must have partaken of all their fluctuations. When they were reduced, the sestertius must have been reduced likewise; for if it had not been so reduced, or, which in effect is the same thing, if it had been necessary to increase the quantity of the degraded denarii and aurei contained in a given sum of sestertii in proportion to their degradation, nothing, it is obvious, could have been gained by falsifying the standard. But as we know that on one occasion the republic got rid of one-half of its debts—respublica dimidium lucrata est—by simply reducing the standard of the as, it is certain that the value of the sestertius must have fallen in the same proportion, just as in England we should reduce the pound sterling, our money *unit*, by reducing the shillings of which it is made up. †

Errors of Dr Arbuthnot and others. But, although it had not been possible to produce such clear and explicit testimony to show the continued degradation of the Roman money, the obvious absurdity of many of the calculations which have been framed, on the supposition of its remaining stationary at the rates fixed in the earlier ages of the commonwealth, would have sufficiently established the fact of its degradation. Dr Arbuthnot's *Tables of Ancient Coins*, which, for nearly a century, have been considered in England, and in the greater part of the Continent, as of the highest authority, are constructed on the hypothesis that the denarii weighed by Mr Greaves were of equal purity with English standard silver, and that no subsequent diminution had been made either in their weight or fineness! The conclusions derived from such data are precisely of the same sort we should arrive at, if, in estimating

* Greaves, Vol. I. p. 331. Gibbon's *Miscellaneous Works*, Vol. V. p. 71.

† All the writers on ancient coins, with the single exception of Mr Pinkerton, agree in supposing the sestertius to have been originally, and to have always continued to be, a *silver* coin. Mr Pinkerton has, however, denied this opinion, and on the authority of the following passage of Pliny, contends that the sestertius was at the time when Pliny wrote, whatever it might have been before, a *brass* coin. "*Summa gloria æris nunc in Marianum conversa, quod et Cordubense dicitur. Hoc a Liviano cadmiam maxime sorbet, et orichalci bonitatem imitatur in* SESTERTIIS, DUPONDIARIISQUE, *Cyprio suo* ASSIBUS *contentis*." (Lib. 31, cap. 2.) That is, literally, "The greatest glory of brass is now due to the Marian, also called that of Cordova. This, after the Livian, absorbs the greatest quantity of *lapis calaminaris*, and imitates the goodness of orichalcum (*yellow brass*) in our SESTERTII and DUPONDIARII, the ASSES being contented with the Cyprian (brass)." (Pliny had previously observed, that the Cyprian was the least valuable brass.) This passage is, we think, decisive in favour of Mr Pinkerton's hypothesis. But, in the absence of positive testimony, the *small value* of the sestertius might be relied on as a sufficient proof that it could not be silver. When the denarius weighed 62 grains, the sestertius must have weighed $15\frac{1}{2}$, and been worth $2\frac{1}{8}$d.; but a coin of so small a size as to be scarcely equal to *one-third* of one of our sixpences, would have been extremely apt to have been lost; and could not have been struck by the rude methods used in the Roman mint with any thing approaching to even tolerable precision. It is, therefore, much more reasonable to suppose that it was of brass.

the value of a French livre previously to the Revolution, we took for granted that it weighed a pound of pure silver, as in the reign of Charlemagne. Among many other things even more extraordinary, we learn from Arbuthnot, that Julius Cæsar, when he set out for Spain, after his prætorship, was just L.2,018,229 Sterling worse than nothing,—that Augustus received, in legacies from his friends, L.32,291,666,—that the estate of Pallas, a *freedman* of Crassus, was worth L.2,421,875, and, which is still better, that he received L.121,093 as a reward for his virtues and *frugality*,—that Æsop, the tragedian, had a dish served up at his table which cost L.4,843,—that Vitellius spent L.7,265,625 in twelve months in eating and drinking,—and that Vespasian, at his accession to the empire, declared, that an annual revenue of L.322,916,666 would be necessary to keep the state machine in motion! It is astonishing, that none of our scholars or commentators seem ever to have been struck with the palpable extravagance of such conclusions—conclusions which, to use the words of Garnier, "ont mis l'Histoire Ancienne, sous le rapport des valeurs, au même degré de vraisemblance que les contes de *Mille et une Nuits!*" They have, we believe, without any exception, slavishly copied the errors of Arbuthnot; and to this hour the computations in the works on Roman antiquities used in our most celebrated schools and universities, are all borrowed from his work! It ought to be remembered, that the value of gold and silver must, because of the greater poverty of the mines of the old world, and the comparatively small progress made by the ancients in the art of mining, have been much greater in antiquity than at present. But, without taking this circumstance into account, the computations referred to are too grossly and obviously erroneous to deserve the smallest attention. Vespasian, we believe, would have been very well satisfied with a revenue of 20 millions; and there are good grounds for supposing that the Roman revenue, when at the highest, never amounted to so large a sum. (Gibbon, Vol. I. p. 260.)

History of the Money of France.

FRENCH MONEY.—From about the year 800, in the reign of Charlemagne, to the year 1103, in the reign of Philip I., the French *livre*, or money unit, contained exactly a pound weight, or 12 ounces (poids de marc) of pure silver. It was divided into twenty sols, each of which, of course, weighed $\frac{1}{20}$th of a pound. This ancient standard was first violated by Philip I., who made a considerable diminution of the quantity of pure silver contained in the sols. The example having been once set, it was so well followed up, that, in 1180, the livre was reduced to less than *one-fourth* part of its original weight of pure silver. In almost every succeeding reign there was a fresh diminution. "La monnoye," says Le Blanc, "qui est la plus precieuse et la plus importante des mesures, a changé en France presque aussi souvent que nos habits ont changé de mode!" And to such an extent had the process of degradation been carried, that, at the epoch of the Revolution, the livre did not contain a SEVENTY-EIGHTH part of the silver contained in the livre of Charlemagne! It would then have required 7885 livres really to extinguish a debt of 100 livres contracted in the ninth or tenth centuries; and an individual who, in that remote period, had an annual income of 1000 livres, was as rich, in respect to money, as those who, at the Revolution, enjoyed a revenue of 78,850 livres. (Paucton, *Traité des Mesures, Poids*, &c. p. 693.)

Degradation of the Livre

We subjoin an abridged table, calculated by M. Denis, exhibiting the average value of the French livre in different periods, from the year 800 to the Revolution:

Reigns.		Years.	Value of the Livre in the Current Money of 1789.		
			Livre.	*Sols.*	*Den.*
From the 32d year of Charlemagne to the 43d year of Philip I., - - - -	or from	800 to 1103,	78	17	0
Part of the reign of Philip I., Louis VI., and VII.	—	1103 — 1180,	18	13	8
Philip II. and Louis VIII. - - -	—	1180 — 1226,	19	18	$4\frac{4}{5}$
Louis IX. and Philip IV. - -	—	1226 — 1314,	18	3	5
Louis X. and Philip V. - -	—	1314 — 1322,	17	3	5
Charles IV. and Philip VI. - -	—	1322 — 1350,	14	11	10
John, - - - - - - -	—	1350 — 1364,	9	19	$2\frac{2}{5}$
Charles V. - - - - -	—	1364 — 1380,	9	9	8
Charles VI. - - - - -	—	1380 — 1422,	7	2	3
Charles VII. - - - - -	—	1422 — 1461,	5	13	9
Louis XI. - - - - -	—	1461 — 1483,	4	19	7
Charles VIII. - - -	—	1483 — 1498,	4	10	7
Louis XII. - - -	—	1498 — 1515,	3	19	8
Francis I. - - -	—	1515 — 1547,	3	11	2
Henry II. and Francis II. - -	—	1547 — 1560,	8	6	$4\frac{4}{5}$
Charles IX. - -	—	1560 — 1574,	2	18	7
Henry III. - - - -	—	1574 — 1589,	2	12	11
Henry IV. - - - - -	—	1589 — 1610,	2	8	0
Louis XIII. - - - -	—	1610 — 1643,	1	15	9
Louis XIV. - - - -	—	1643 — 1715,	1	4	11
Louis XV. - - - -	—	1715 — 1720,	0	8	0
Louis XV. and XVI. - -	—	1720 — 1789,	1	0	0

Those who wish for a full and detailed account of the various changes in the weight and purity of the French coins, may, besides the excellent work of Le Blanc, consult the elaborate and very complete tables at page 905 of the *Traité des Mesures* of Paucton; and at page 197 of the *Essai sur les Monnoies* of Dupré de St Maur.

It was not to be expected, that degradations originating in the necessities, the ignorance, and the rapacity of a long series of arbitrary princes, should be made according to any fixed principle. They were sometimes the result of an increase in the denomination of the coins; but more frequently of a diminution of the purity of the metal of which they were struck. A degradation of this kind was not so easily detected, and, in order to render its discovery still more difficult, Philip of Valois, John, and some of the other kings, obliged the officers of the mint to swear to conceal the fraud, and to endeavour to make the merchants believe that the coins were of full value! (Le Blanc, p. 212.) Sometimes one species of money was reduced, without any alteration being made in the others. No sooner, however, had the people in their dealings manifested a preference, as they uniformly did, for the money which had not been reduced, than its circulation was forbidden, or its value brought down to the same level with the rest. (*Id.* Introduction, p. 20.) In order to render the subject more obscure, and the better to conceal their incessant frauds, individuals were at one time compelled to reckon exclusively by livres and sols, at other times by crowns or ecus, and not unfrequently they were obliged to refer in computing to coins which were neither livres, sols, nor crowns, but some multiple or fractional part thereof. The injurious effects of these constant fluctuations in the value of money are forcibly depicted by the French historians. And so insupportable did they become, that, in the fourteenth and fifteenth centuries, several cities and provinces were glad to purchase the precarious and little respected privilege of having coins of a fixed standard, by submitting to the imposition of heavy taxes. (Le Blanc, p. 93.)

In the duchy of Normandy, when it was governed by the English monarchs, there was a tax on hearths paid every three years, called *monetagium*, in return for which the sovereign engaged *not to debase his coins*. This tax was introduced into England by our early kings of the Norman race; but Henry I. in the first year of his reign, was induced to abandon it, and it has not since been revived. (Liverpool *On Coins*, p. 107.)

According to the present regulations of the French Mint, the coins contain $\frac{9}{10}$ths of pure metal, and $\frac{1}{10}$th of alloy. The *franc*, which is equal to 1 livre, 0 sols, 3 deniers, weighs exactly 5 grammes, or 77.2205 English Troy grains. The gold piece of 20 francs weighs 102.96 English grains. (Peuchet, *Statistique Elementaire de la France*, p. 538.)

Of England.

English Money.—In England, at the epoch of the Norman Conquest, the silver, or money pound, weighed exactly twelve ounces Tower weight. It was divided into twenty shillings, and each shilling into twelve pence, or sterlings. This system of coinage, which is in every respect the same with that established in France by Charlemagne, had been introduced into England previously to the invasion of William the Conqueror, and was continued, without any alteration, till the year 1300, in the 28th Edward I., when it was for the first time violated, and the value of the pound Sterling degraded to the extent of $1\frac{17}{81}$ *per cent.* But, the really pernicious effect of this degradation did not consist so much in the trifling extent to which it was carried by Edward, as in the example which it afforded to his less scrupulous successors, by whom the standard was gradually debased, until, in 1601, in the reign of Queen Elizabeth, 62s. were coined out of a *pound* weight of silver. This was a reduction of above *two-thirds* in the standard; so that all the stipulations in contracts, entered into in the reigns immediately subsequent to the Conquest, might, in 1601, and since, be legally discharged by the payment of less than *one-third* of the sums that had been really bargained for. And yet the standard has been much less degraded in England than in any other country!

Degradation of the Pound Sterling.

The tables annexed to this article give an ample account of these degradations, and also give the weight of the gold coins, and the proportional value of gold to silver, estimated both by the mint regulations, and by the quantity of fine gold and fine silver contained in the different coins.

Of Scotland.

Scottish Money.—In the same manner as the English had derived their system of coinage from the French, the Scots derived theirs from the English. From 1296 to 1355, the coins of both divisions of the island were of the same size and purity. But, at the last mentioned period, it was attempted to fill up the void occasioned by the remittance of the ransom of David II. to England, by a degradation of the coins. Till this time, the money of Scotland had been current in England, upon the same footing with the money of that country; and the preservation of this equality is assigned by Edward III. as a reason for his degrading the English coins. But this equilibrium was soon after deranged. In the first year of Robert III. (1390), the Scottish coin only passed for half its nominal value in England; and, in 1393, Richard II. ordered that its currency, as money, should entirely cease, and that its value should be made to depend exclusively on the weight of the genuine metal contained in it. "To close this point at once," says Mr Pinkerton, "the Scottish money, equal in value to the English till 1355, sunk by degrees, reign after reign, owing to succeeding public calamities, and the consequent impoverishment of the kingdom, till, in 1600, it was only a *twelfth* part of the value of English money of the same denomination, and remained at that point till the union of the kingdoms cancelled the Scottish coinage."—(*Essay on Medals*, Vol. II. p. 99.)

The tables at the end of this article exhibit the successive degradations both of the Scottish silver and gold coins.

At the Union, in 1707, it was ordered that all the silver coins current in Scotland, foreign as well as domestic, except English coins of full weight, should be brought to the Bank of Scotland, to be carried to the mint to be recoined. In compliance with this order, there was brought in,

	L.	s.	d.
Of foreign silver money (Sterling),	132,080	17	9
Milled Scottish coins, -	96,856	13	0
Coins struck by hammer, -	142,180	0	0
English milled coin, -	40,000	0	0
Total,	L.411,117	10	9

Mr Ruddiman conjectures, apparently with considerable probability, that the value of the Scottish gold coins, and of the silver coins not brought in, amounted to about as much more. Much suspicion was entertained of the measure of a recoinage; and that large proportion of the people who were hostile to the Union, and who did not conceive it could be permanent, brought very little of their money to the bank. Only a few of the hoarded coins have been preserved, the far greater part having either been melted by the goldsmiths, or exported to other countries. (Preface to Anderson's *Diplomata*, p. 176.)

Of Ireland.

IRISH MONEY.—The gold and silver coins of Great Britain and Ireland are now the same, and have been so for a considerable period. The rate, however, at which these coins circulate in Ireland, or their nominal value as money of account, is $8\frac{1}{3}$ *per cent.* higher than in Great Britain. This difference of valuation, which is attended with considerable inconvenience in adjusting the money transactions between the two countries, has subsisted since 1689. For an account of the various species of metallic money which have at different times been current in Ireland, we must refer our readers to Mr Simons' *Essay on Irish Coins*,*—a work pronounced by Mr Ruding to be "the most valuable of all the publications on the coinage of any part of the united empire."—(*Annals of the Coinage*, Preface, Vol. I. p. 11.)

Of Germany, &c.

MONEY OF GERMANY, SPAIN, &c.—A similar process of degradation had been universally carried on. "In many parts of Germany, the florin, which is still the integer, or money of account of those countries, was originally a *gold* coin, of the value of about 10s. of our present money (old coinage). It is now become a silver coin, of the value of only 20d.; and its present value, therefore, is only equal to a sixth part of what it was formerly. In Spain, the maravedi, which was in its origin a Moorish coin, and is still the money of account of that kingdom, was in ancient times most frequently made of gold. Le Blanc observes, that, in 1220, the maravedi weighed 84 grains of gold, equal in value to about 14s. (old coinage) of our present money. But this maravedi, though its value is not quite the same in all the different provinces of Spain, is now become a small copper coin, equal in general to only $\frac{13}{272}$ of an English penny! In Portugal, the re, or reis, is become of no greater value than $\frac{67}{101}$ of an English penny; it is so small, that, in estimating its value in other coins, it is reckoned by hundreds and thousands. The moeda, or moidore, is equal to 4800 reis; and this little coin has now, in fact, no existence but in name. Such has been the fate of all these coins, and such is their present state of their depreciation."—(Liverpool *on Coins*, p. 111.)

Of Russia.

RUSSIAN MONEY.—The following, according to M. Storch, are the fluctuations in the weight and value of the rouble, or *money unit* of Russia, since 1700.

Years.	Weight of the Rouble.		Value in Current Roubles of 1821.	
	Zolot.	*Dolis.*	*Rou.*	*Cop.*
1700 -	11	40	2	70½
From 1700 to 1718,	5	67	1	35
— 1718 — 1731,	4	83	1	15½
— 1731 — 1762,	5	16	1	22½
— 1762 — 1821,	4	21	1	0

Raising of the Value of the Coin.

The principle of degradation has not, however, been uniformly acted upon. The quantity of bullion contained in coins of the same denomination has sometimes, though rarely, been increased, and creditors enriched at the expence of their debtors. This method of swindling his subjects is said to have been first practised by Heliogabalus. The Roman citizens being bound to pay into the imperial treasury, not a certain weight of gold, but a certain number of pieces of gold, or *aurei*, the Emperor, whose vices have become proverbial, in order to increase his means of dissipation, without appearing to add to the weight of the taxes, increased the quantity of metal contained in the *aureus;* and thus obtained, by a dishonest trick, what it might have been difficult for him to have obtained by a fair and open proceeding. † In France, the value of the coins has been frequently raised. During the early part of the reign of Philip le Bel, who ascended the throne in 1285, the value of the coin had been reduced to such an extent as to occasion the most violent complaints on the part of the clergy and landholders, and generally of all that portion of the subjects who could not raise their incomes proportionably to the reduction in the value of money. To appease this discontent, and in compliance with an injunction of the Popes, the king at last consented to issue new coins, of the same denomination with those previously current, but which contained about *three* times the quantity of silver. This, however, was merely shifting an oppressive burden from the shoulders of one class to those of another, who were less able to bear it. The degraded money having been in circulation for about *sixteen*

* Originally printed at Dublin in 1749, in 4to, and reprinted with some additions in 1810.

† Lamp. *Vita Alex. Severi*, Cap. 39.—Perhaps Heliogabalus took the hint from Licinius, a freedman of Cæsar's, who, in his government of the Gauls under Augustus, divided the year into fourteen months instead of twelve, because the Gauls paid a certain *monthly* tribute!—Dion Cassius, Lib. 72.

years, by far the largest proportion of the existing contracts must have been adjusted exclusively with reference to its value. No wonder, therefore, that those who were in the situation of debtors should have declared their repugnance to submit to so shameful an act of injustice as was done them by this enhancement of the value of money, and that they should have refused to make good their engagements, otherwise than in money of the value of that which had been current at the time when they were entered into. The labouring class, to whom every sudden rise in the value of money is always injurious, having joined the debtors in their opposition, they broke out into open rebellion. "The people," says Le Blanc, "being reduced to despair, and having no longer any thing to care for, lost the respect due to the edict of his Majesty;—they pillaged the house of the master of the mint, who was believed to have been the chief adviser of the measure, besieged the temple, in which the King lodged, and did all that an infuriated populace is capable of doing." (*Traité Historique des Monnoyes de France*, p. 190.) The sedition was ultimately suppressed; but it is not mentioned whether any abatement was made, by authority, from the claims of the creditors, in the contracts entered into when the light money was in circulation. It seems probable, however, from what is elsewhere mentioned by Le Blanc (Introduction, p. 30), that such was really the case.

Increase of the Value of the English Coins in the Reign of Edward VI

The history of the French coinage affords several instances similar to the very remarkable one we have now brought under the notice of our readers; but, in England, the new coinage in the last year of the reign of Edward VI. is the only instance in which the value of money has been augmented by the direct interference of government. Previously to the accession of Henry VIII., the pound of standard silver bullion, containing 11 oz. 2 dwts. of pure silver, and 18 dwts. of alloy, was coined into thirty-seven shillings and sixpence. But Henry not only increased the number of shillings coined out of a pound weight of silver, but also debased its purity. The degradation was increased under his son and successor, Edward VI., in the fifth year of whose reign, seventy-two shillings were coined out of a pound weight of bullion; but this bullion only contained *three* ounces of pure silver to *nine* ounces of alloy; so that, in fact, twenty of these shillings were only equal to 4s. 7¾d. of our present money, including the seignorage. (Folkes's *Table of English Coins*, p. 34.) It appears from the proclamations issued at the time, and from other authentic documents, that this excessive reduction of the value of silver money had been productive of the greatest confusion A *maximum* was set on the price of corn and other necessaries; and letters were sent to the gentlemen of the different counties, desiring them to punish those who refused to carry their grain to market. But it was soon found to be quite impossible to remedy these disorders otherwise than by withdrawing the base money from circulation. This was accordingly resolved upon; and, in 1552, new coins were issued, the silver of which was restored to the old standard of purity, and which, though less valuable than those in circulation during the early part of the reign of Henry VIII., were above *four* times the value of a large proportion of the same denomination that had been in circulation for some years before.

It is clear to demonstration, however, that such a rise in the value of money could not have taken place without occasioning the most violent commotions, had *all* the coins previously in circulation been debased. Equal injustice, it must be remembered, is always done to the poorest, and not least numerous class of society, by increasing the value of money, as is done to the wealthier classes by depressing it. But, although government had been disposed to sanction so enormous an invasion of the right of property, it is altogether impossible that the country could have submitted to have had 400 or 450 *per cent.* added to its taxes and other public burdens, by a piece of legerdemain of this kind, or that individuals would have consented to pay so much more than they had originally bargained for. Instead of deserving praise for accomplishing such a measure, Edward VI., by whom the reformation of the coins was begun, and Elizabeth, by whom it was completed, would have justly forfeited the esteem of their subjects, and merited the deepest execration. The truth is, however, that almost no change had been made, during all this period, in the value of the *gold* coins; and there is, besides, abundance of evidence to show, that a large supply of the old silver coins had remained in circulation. Now, as there is no mention made of the issue of the new coins having been attended with any inconvenience, it is nearly certain, as Mr Harris has remarked, that, during the period of the debasement of the standard, individuals had regulated their contracts chiefly with reference to the gold or old silver coins; or, which is the same thing, that "they had endeavoured, as well as they could, *to keep by the standard, as it had been fixed in the preceding times.*" (Harris *On Coins*, Part II. p. 3.)

We have been thus particular in examining this measure, because it has, of late, been much referred to. It is plain, however, that it can give no support to the arguments of those who have appealed to it as affording a striking proof of the benefits which they affirm must always result from restoring a debased or degraded currency to its original purity or weight. Invariability of value is the great desideratum in a currency. To elevate the standard after it has been for a considerable period depressed, is really not a measure of justice, but the giving *a new direction to injustice*. It vitiates and falsifies the provisions in one set of contracts, in order properly to adjust those in some other set!

This, however, as we have already remarked, is the only instance in which the government of England has ever interfered directly to enhance the value of money. In every other case, where they have tampered with the standard, it has been to lower its value, or, which comes to the same thing, to reduce their own debts and those of their subjects.

Pernicious Effects of a Reduction of the Standard.

It is unnecessary to enumerate in detail the various bad consequences that must have resulted from these successive changes in the standard of value. But, it deserves to be remarked, that an arbitrary reduction of the standard does not afford any real relief to the embarrassments of the governments by whom

Money.

it is practised. Their *debts* are, it is true, reduced in proportion to the reduction in the value of the currency, but their *revenues* are also reduced in the same proportion. A degraded piece of money will not exchange for the same quantity of commodities. To whatever extent the standard of money may be reduced, prices must, very soon, be raised to the same extent. If the degradation be 10 *per cent.*, the government, as well as every one else, will, henceforth, be compelled to pay L.110 for those commodities which it might previously have obtained for L.100. To bring the same real value into the coffers of the treasury, it is necessary, therefore, that taxation should be increased whenever the standard is diminished—a measure always odious, and in some countries impracticable.

But a diminution of revenue is not the only bad effect which governments experience from reducing the standard of the currency. A state which has degraded its money, and cheated its creditors, is unable to borrow again on the same favourable terms as if it had acted with perfect good faith. We cannot expect to enjoy the reputation of honesty, at the same time that we are openly pocketing the booty earned by duplicity and treachery. Those who lend money to knaves always stipulate for a proportionably high rate of interest. They must not only obtain as much as they could have obtained from the most secure investments, but they must also obtain an *additional* rate or premium, sufficient to cover the risk they run in transacting with those who have given proofs of bad faith, and on whose promises no reliance can be placed. A degradation of the standard of value is, therefore, of all others, the most wretched resource of a bankrupt government. It will never, indeed, be resorted to, except by those who are alike unprincipled and ignorant. "It occasions," says Dr Smith, "a general and most pernicious subversion of the fortunes of private people; enriching, in most cases, the idle and profuse debtor at the expence of the frugal and industrious creditor; and transporting a great part of the national capital from the hands which were likely to increase and improve it, to those which are likely to dissipate and destroy it. When it becomes necessary for a state to declare itself bankrupt, in the same manner as when it becomes necessary for an individual to do so, a fair, open, and avowed bankruptcy, is always the measure which is both least dishonourable to the debtor, and least hurtful to the creditor. The honour of a state is surely very poorly provided for, when, in order to cover the disgrace of a real bankruptcy, it has recourse to a juggling trick of this kind, so easily seen through, and at the same time so utterly pernicious."—(*Wealth of Nations*, Vol. III. p. 435.)

Some of the bad consequences resulting from a change in the value of money might, indeed, be obviated, by enacting, that the stipulations in all precedent contracts should be made good, not according to the present value of money, but to its value at the time when they were entered into. This principle, which is conformable to the just maxim of the civil law—*Valor monetæ considerandus atque inspiciendus est, a tempore contractus, non autem a tempore solutionis*—was acted upon, to a certain extent, at least, by the Kings of France during the middle ages. Ordonnances of Philip le Bel, Philip of Valois, and Charles VI., issued subsequently to their having *increased* the value of money, or, as the French historians term it, returned from the *foible* to the *forte* monnoie, are still extant, in which it is ordered, that all previous debts and contracts should be settled by reference to the previous standard. But although the same reason existed, it does not appear that any such ordonnances were ever issued when the value of money was degraded. It is obvious, indeed, that no government could derive any advantage whatever from reducing the value of money, if it were to order, as it is in justice bound to do, that all *existing* contracts should be adjusted by the old standard. Such a measure would reduce the revenue without reducing the incumbrances of the state; while, by establishing a new standard of value, and unsettling all the notions of the public, it would open a door for the grossest abuses, and be productive of infinite confusion and disorder in the dealings of individuals.

The odium and positive disadvantage attending the degradation of the value of metallic money, appears to have at length induced almost all governments to abstain from it. But they have only renounced one mode of playing at fast and loose with the property of their subjects, to adopt another and a still more pernicious one. The injustice which was formerly done by diminishing the quantity of bullion contained in the coins of different countries, is now perpetrated with greater ease, and to a still more ruinous extent, by the depreciation of their paper currency.*

From 1601 to 1797, no change made in the Standard.

In the long period from 1601 to 1797, no change was made in the standard of money in this country. A project for enfeebling the standard had indeed been entertained, both in 1626 and 1695; but, in the former instance, it was quashed by the celebrated speech addressed by Sir Robert Cotton to the Lords of the Privy Council, and in the latter by the opposition of Mr Montague, then Chancellor of the Exchequer, in the House of Commons, and by the impression made by the writings of Mr Locke, by whom the injustice of the scheme was admirably exposed, out of doors. It was reserved for Mr Pitt to set aside a standard which had been thus preserved inviolate for nearly two centuries. The Order in Council of the 25th February 1797, and the acts of Parliament by which it was followed up, effected a total change in our ancient monetary system; and, instead of the old standard, gave us the *self-interest-*

* In the sixth volume of the *Cours d'Economie Politique* of M. Storch, there is a very instructive account of the paper money of the different continental states. We can confidently recommend it as containing a great deal of new and important information.

Money.

ed views and opinions of twenty-four irresponsible individuals. The circulation of Bank of England paper was secured, by its being exclusively issued in payment of the dividends, or of the interest of the public debt, and by its also being received as cash in all payments into the exchequer; but no attempt was made to sustain the value of this paper on a par with the value of gold or silver. Full power was given to the directors of a private banking company to raise or depress the value of money, as their interest or caprice might suggest. They were enabled to exchange unlimited quantities of bits of engraved paper, of the intrinsic worth, perhaps, of 5s. a quire, for as many, or the value of as many, hundreds of thousands of pounds. And, in such circumstances, our only wonder is, not that paper money became depreciated, but that its value was not more reduced—that a still greater quantity of bank-notes were not thrust into circulation.

Effects of the Restriction in 1797, in degrading the Value of Bank Paper.

For the first three or four years after the restriction, the Directors, ignorant, perhaps, of the nature of the immense power which had been placed in their hands, seem to have regulated their issues nearly on the same principles that they had regulated them by, while they were obliged to pay in coin. It appears, by the *Tables of the Price of Bullion*, published by order of the House of Commons, that, until 1801, bank-notes were on a par with gold. In 1801 and 1802, however, they were at a discount of from $8\frac{1}{3}$ to $7\frac{1}{2}$ *per cent.*; but they again recovered their value; and, from 1803 to 1809, both inclusive, they were only at a discount of L. 2, 13s. 2d. *per cent.* But, in 1809 and 1810, the Directors appear to have totally lost sight of every principle by which their issues had previously been governed. The average amount of bank-notes in circulation, which had never exceeded $17\frac{1}{2}$ millions, nor fallen short of $16\frac{1}{2}$ millions in any one year from 1802 to 1808, both inclusive, was, in 1809, raised to L.18,927,833; and, in 1810, to L.22,541,523. The issues of country bank paper were increased in a still greater proportion; and, as there was no corresponding increase in the business of the country, the discount on bank-notes rose from L.2, 13s. 2d. in 1809, to L.13, 9s. 6d. *per cent.* in 1810! The recommendation to return to cash payments, contained in the *Report of the Bullion Committee*, presented to the House of Commons in 1810, appears to have given a slight check to the issues of the Bank. All apprehensions from this quarter were, however, speedily dissipated; for, in May 1811, when guineas were notoriously bought at a premium, and bank-notes were at an open discount, as compared with gold bullion, of upwards of 10 *per cent.*, the House of Commons not only refused to fix any certain period for reverting to cash payments, but actually voted a resolution, declaring that the promissory notes of the Bank of England had *hitherto been, and were* AT THAT TIME, *held to be, in public estimation, equivalent to the legal coin of the realm!*

Extraordinary Resolution of the House of Commons.

This ever memorable resolution—a resolution which took for granted, that a part was equal to a whole—that L.90 and L.100 were the same thing—relieved the Bank from all uneasiness respecting the interference of Parliament, and stimulated the Directors to increase the number of their notes in circulation. The consequence was, that, in 1812, they were at an average discount of $20\frac{3}{4}$; in 1813, of 23; and, in 1814, of 25 *per cent.!* This was the *maximum* of depreciation. The importation of foreign corn, subsequent to the opening of the Dutch ports in 1814, by occasioning a great decline of the price of the principal article of agricultural produce, produced an unprecedented degree of distress, first among the farmers, and latterly among the country bankers. It is estimated that, in 1814, 1815, and 1816, no fewer than 240 private banking companies either became altogether bankrupt, or, at least, stopped payment; and the reduction that was thus occasioned in the quantity of bank-notes in circulation, raised their value so rapidly, that, in October 1816, the discount was reduced to L.1, 8s. 7d. *per cent.* In 1817 and 1818, the average discount on bank paper, as compared with gold, did not exceed L.2, 13s. 2d. *per cent.* In the early part of 1819, it rose to about 6 *per cent.*; but it very soon declined; and, for the last two years, paper has been nearly on a level with gold. (See Table No. V. annexed to this article.)

Money.

Bankruptcy of the Country Banks in 1814, 1815, and 1816, cause of the Rise in the Value of Bank Paper.

Nothing that has ever happened in the history of the country has proved more injurious to its best interests than these fluctuations. From 1809 to 1815, the creditors of every antecedent contract, landholders whose estates had been let on lease, stockholders and annuitants of every description—all, in short, who could not raise the nominal amount of their claims or of their incomes proportionably to the fall in the real value of money, were robbed of a corresponding portion of them. The injustice that would have been done to the creditors of the state and of individuals, who had made their loans in gold or paper equivalent to gold, by raising the denomination of the coin 25 *per cent.*, however gross and palpable, would not have been greater than was actually done them in 1814, by compelling them to receive payment of their just debts in paper depreciated to that extent. Circumstances which could neither be controlled by the Bank of England nor the Government, put an end, as we have just seen, to this monstrous system. But we are still suffering, and will long continue to suffer severely, for the folly and injustice of which we have been guilty. The mischief occasioned by the sudden reduction of the paper currency, and the consequent rapid augmentation of its value, has been still greater than what had previously been caused by its depreciation. The hardship occasioned by the subversion of private fortunes, and by the change in the debts and credits of individuals, might be, in both cases, nearly equal. A vast amount of public debt was, however, contracted during those years in which the depreciation was greatest; and the state is now paying this debt, borrowed when the bank-note was not worth more than 14s. or 15s., with bank-notes whose value is increased to 20s. The salaries, too, of all our public officers, and the expences of the army and navy, and of all our other public establishments, had been generally augmented proportionably to the reduced value of money. And as no corresponding reduction has been made from the sums voted on their account since the currency recovered its value,

Money.

it is easy to perceive, that a very great addition has thus been made to the public expenditure. All those taxes, too, which were imposed when the currency was depreciated, must now, though not nominally, be really increased in the same proportion; so that, when sufficient allowance has been made for the difference in the value of money, it is doubtful whether the country be not more heavily burdened at this moment than it was in 1813 and 1814, though we have since got rid of the income-tax—a tax which produced about 14 millions a year!

Such is but a brief and imperfect outline of the very great and almost irreparable injury which the late fluctuations in the value of the currency have entailed on the country. And yet, strange to tell, there is a considerable party amongst us who, not satisfied with this pernicious transference of property from the pockets of those who ought to possess it, to the pockets of those who have no right to it whatever—are clamouring for a fresh reduction of the standard! And it is, indeed, unquestionably true, as we have already had occasion to show, that after a currency has been for a considerable period depreciated, equal injustice is done by again raising its value, as was done by first depressing it. There is good reason, however, to doubt, whether the depreciation from 1809 to 1815 (for the depreciation of $2\frac{1}{2}$ *per cent.* during the seven preceding years is too inconsiderable to be taken into account) extended over a sufficiently lengthened period to have warranted the Legislature in departing from the old standard. But, without giving any opinion on this point, which is confessedly one of considerable difficulty, it is sufficient to remark, that the value of the currency was raised, *independently altogether of the interference of Government*. The destruction of country bank paper, occasioned by the renewed intercourse with the continent, and the consequent introduction of cheap foreign corn, had raised the value of paper currency, in October 1816, to within $1\frac{1}{2}$ *per cent.* of par. Now, as the act 59th Geo. III. was not passed until 1819, and as the currency had not been depreciated in the interim, we frankly confess our inability to discover the grounds on which *it* is affirmed to have been the *cause* of that rise in the value of money which took place *three years before it was in existence!* The proceedings in 1819 did not really add 3 *per cent.** to the value of bank paper, nor were they intended to raise it. Their great object was to shut the door against a *new* depreciation, and to prevent the value of paper, which had, for *three* years, been nearly on a level with gold, from being again degraded. By maintaining the *old* standard, or, which is the same thing, by maintaining the currency at a value nearly corresponding to that to which it had attained in 1816, 1817, and 1818, Parliament certainly gave permanence to the serious injury which the rise in the value of money had occasioned to the debtors in all the contracts entered into betwe[en] 1810 and 1815; but if, instead of maintaining this old standard, they had raised the mint price of bullion to its market price in 1814, they would have done an equal injury to the far more numerous body of creditors, in *all the contracts entered into previously to* 1810, *and in the three years subsequent to autumn* 1816.

Act 59th Geo. III. did not raise the Value of the Currency.

Standard as now fixed ought to be maintained inviolate.

In these circumstances, it was impossible to adopt any measure capable of giving general satisfaction to those whose interests were so widely different; and against which many plausible, and even forcible objections, might not have been stated. We are firmly persuaded, however, that the Legislature followed that course which was, on the whole, the wisest and most advantageous. It must be remembered, that much of that inconvenience and distress, which must always result from every sudden rise in the value of money, had been got over in 1817 and 1818. The rents of such farms as had been let during the depreciation had been very generally reduced; a vast number of annuity bonds had been cancelled, and prices and wages had begun to accommodate themselves to the new scale of value. The adoption of Mr Peel's bill only gave stability to arrangements which had been brought about by the natural course of events; and, by fixing the standard at its former limit, secured us, as long at least as we have good sense and honesty to maintain it inviolate, against the risk of future derangement and fluctuation.

But, even if it could be shown that the act 59th Geo. III. was inexpedient at the time when it was passed, that would add but little real strength to the plea of those who are now contending for its repeal. Every objection which it was possible to make to the degradation of the standard in 1819, must apply with tenfold force to the scheme for degrading it in 1821: while, on the other hand, all the arguments that could have been urged in favour of the measure at the former period must now be proportionably weakened. Two years more have been afforded for the completion of those arrangements which had been begun in 1817 and 1818; and an immense variety of new contracts and engagements have been entered into, exclusively with reference to the present value of money. A fresh reduction of the standard would vitiate all these engagements, and plunge us of new into that confusion and embarrassment from which we have now nearly escaped. We should again witness the most pernicious subversion of private fortunes. Debtors would be again enriched at the expence of their creditors; the ignorant and unwary would again become the prey of the cunning and the crafty; and capitalists would be eager to transfer their stock from a country where it would be impossible to lend it, except at the risk of getting it repaid in a depreciated currency. "Whatever, therefore," to avail ourselves of the just and forcible expressions of Mr Harris, "may be the fate of future times, and whatever the exigency of affairs may require, it is to be hoped that that most awkward, clandestine, and most direful method, of cancelling debts by debasing the standard of money, will be the last that shall be thought of."—(*On Money and Coins*, Part II. p. 108.)

* At the period when Mr Peel's bill was passed, bullion was at L. 4 an ounce; consequently, the depreciation was only L. 2, 13s. 2d. *per cent.*

Tables relative to the Money of Great Britain and other Countries.

No. I. English Money.—*Account of the English Silver and Gold Coins; showing their Value; the Seignorage or Profit upon the Coinage, and the Price paid to the Public by the Mint, for the Pound Troy of Standard Gold and Silver, from the Conquest to the year* 1816. (*This and the next Table, No. II., are taken from Part II. of* Essays on Money, Exchanges, and Political Economy, *by Henry James.*)

SILVER.

A. D.	Anno Regni.	1. Fineness of the Silver in the Coins.		2. Pound-weight of such Silver coined into			3. Profit or Seignorage on the Coinage.			4. Prices paid to the Public for the Pound-wt. of Silver.			5. Equal to the Mint-Price for Standard Silver of 11oz. 2dwts. fine Troy-weight.		
		oz.	dts.	L.	s.	d.	L.	s.	d.	L.	s.	d.	L.	s.	d.
1066	Conquest………	11	2	1	0	0	………			………			………		
1280	8 Edward I…	—	—	1	0	0	0	1	0	0	19	0	1	0	$3\frac{1}{5}$
1300	28 ———	—	—	1	0	3	0	1	$2\frac{1}{2}$	0	19	$0\frac{1}{2}$	………		
1344	18 Edward III.	—	—	1	0	3	0	1	3	0	19	0	1	0	$3\frac{1}{5}$
1349	23 ———	—	—	1	2	6	0	1	3	1	1	3	1	2	8
1356	30 ———	—	—	1	5	0	0	0	10	1	4	2	1	5	$9\frac{1}{5}$
1394	18 Richard II..	—	—	1	5	0	0	0	10	1	4	2	1	5	$9\frac{1}{5}$
1401	3 Henry IV…	—	—	1	5	0	0	0	10	1	4	2	1	5	$9\frac{1}{5}$
1421	9 Henry V….	—	—	1	10	0	0	1	0	1	9	0	1	10	$11\frac{1}{5}$
1425	4 Henry VI…	—	—	1	10	0	0	1	0	1	9	0	1	10	$11\frac{1}{5}$
1464	4 Edward IV.	—	—	1	17	6	0	4	6	1	13	0	1	15	$2\frac{1}{5}$
1465	5 ———	—	—	1	17	6	0	4	6	1	13	0	1	15	$2\frac{1}{5}$
1470	49 Henry VI..	—	—	1	17	6	0	2	0	1	15	6	1	17	$10\frac{2}{5}$
1482	22 Edward IV.	—	—	1	17	6	0	1	6	1	16	0	1	18	$4\frac{1}{5}$
1483	1 Rich. III….	—	—	1	17	6	0	1	6	1	16	0	1	18	$4\frac{1}{5}$
1485	1 Henry VII.	—	—	1	17	6	0	1	6	1	16	0	1	18	$4\frac{1}{5}$
1509	1 Henry VIII.	—	—	1	17	6	0	1	0	1	16	6	1	18	$11\frac{1}{5}$
*1527	18 ———	—	—	2	0	0	0	1	$0\frac{1}{5}$	1	18	$11\frac{1}{5}$	1	18	$11\frac{1}{5}$
———	———	—	—	2	5	0	0	1	0	2	4	0	2	4	0
……	………	…	…	………			………			………			………		
1543	34 ———	10	0	2	8	0	0	8	0	2	8	0	2	4	$4\frac{1}{5}$
1545	36 ———	6	0	2	8	0	2	0	0	2	16	0	2	11	$9\frac{3}{5}$
1546	37 ———	4	0	2	8	0	4	4	0	3	0	0	2	15	6
1547	1 Edward VI.	4	0	2	8	0	4	4	0	3	0	0	2	15	6
1549	3 ———	6	0	3	12	0	4	0	0	3	4	0	2	19	$2\frac{2}{5}$
1551	5 ———	3	0	3	12	0	………			………			………		
———	———	11	0	3	0	0	………			………			………		
———	———	…	…	………			………			………			………		
1552	6 ———	11	1	3	0	0	0	1	0	2	19	0	2	19	$3\frac{1}{5}$
———	———	…	…	………			………			………			………		
1553	1 Mary………	11	0	3	0	0	0	1	0	2	19	0	2	19	$6\frac{2}{5}$
1560	2 Elizabeth …	11	2	3	0	0	0	1	6	2	18	6	2	18	6
———	———	…	…	………			………			………			………		
1600	43 ———	—	—	3	2	0	0	2	0	3	0	0	3	0	0
———	———	…	…	………			………			………			………		
1604	2 James I……	—	—	3	2	0	0	2	6	2	19	6	2	19	6
1626	2 Charles I….	—	—	3	2	0	0	2	0	3	0	0	3	0	0
†1666	18 Charles II…	—	—	3	2	0	0	0	0	3	2	0	3	2	0
1717	3 George I….	—	—	3	2	0	0	0	0	3	2	0	3	2	0
1816	56 George III..	—	—	3	6	0	0	4	0	………			………		

GOLD.

A. D.	Anno Regni.	6. Fineness of the Gold in the Coins.		7. Pound-weight of such Gold coined into			8. Profit or Seignorage on the Coinage.			9. Price paid to the Public for the Pound-wt. of Gold.			10. Equal to the Mint-Price for Standard Gold of 22 carats fine Troy-wt.		
		crts.	gns.	L.	s.	d.	L.	s.	d.	L.	s.	d.	L.	s.	d.
1066	Conquest………	..	..	………			………			………			………		
1280	8 Edward I…	..	..	………			………			………			………		
1300	28 ———	..	..	………			………			………			………		
1344	18 Edward III.	23	$3\frac{1}{2}$	13	3	4	0	8	4	12	15	0	12	10	8
1349	23 ———	—	—	14	0	0	0	11	8	13	8	4	13	3	9
1356	30 ———	—	—	15	0	0	0	6	8	14	13	4	14	8	1
1394	18 Richard II..	—	—	15	0	0	0	5	0	14	15	0	14	9	11
1401	3 Henry IV…	—	—	15	0	0	0	5	0	14	15	0	14	9	11
1421	9 Henry V….	—	—	16	13	4	0	5	0	16	8	4	16	2	9
1425	4 Henry VI…	—	—	16	13	4	0	5	10	16	7	6	16	1	11
1464	4 Edward IV.	—	—	20	16	8	2	10	0	18	6	8	18	0	5
1465	5 ———	—	—	22	10	0	1	0	10	21	9	2	21	1	10
1470	49 Henry VI..	—	—	22	10	0	0	13	6	21	17	0	21	9	7
1482	22 Edward IV.	—	—	22	10	0	0	7	6	22	2	6	21	15	0
1483	1 Rich. III….	—	—	22	10	0	0	7	6	22	2	6	21	15	0
1485	1 Henry VII.	—	—	22	10	0	0	7	6	22	2	6	21	15	0
1509	1 Henry VIII.	—	—	22	10	0	0	2	6	22	7	6	22	0	0
*1527	18 ———	—	—	24	0	0	0	2	8	23	17	4	22	0	0
———	———	—	—	27	0	0	0	2	9	26	17	3	………		
……	………	22	0	25	2	6	0	3	0	24	19	6	24	19	6
1543	34 ———	23	0	28	16	0	1	4	0	27	12	0	26	8	0
1545	36 ———	22	0	30	0	0	2	10	0	27	10	0	27	10	0
1546	37 ———	20	0	30	0	0	5	0	0	27	10	0	27	10	0
1547	1 Edward VI.	20	0	30	0	0	1	10	0	28	10	0	31	7	0
1549	3 ———	22	0	34	0	0	1	0	0	33	0	0	33	0	0
1551	5 ———	..	..	………			………			………			………		
———	———	23	$3\frac{1}{2}$	36	0	0	………			………			………		
———	———	22	0	33	0	0	………			………			………		
1552	6 ———	23	$3\frac{1}{2}$	36	0	0	0	2	9	35	17	3	………		
———	———	22	0	33	0	0	0	3	0	32	17	0	32	17	0
1553	1 Mary………	23	$3\frac{1}{2}$	36	0	0	0	3	0	35	17	0	33	0	8
1560	2 Elizabeth …	23	$3\frac{1}{2}$	36	0	0	0	5	0	35	15	0	………		
———	———	22	0	33	0	0	0	4	0	32	16	0	32	16	0
1600	43 ———	23	$3\frac{1}{2}$	36	10	0	0	10	0	36	0	0	………		
———	———	22	0	33	10	0	0	10	0	33	0	0	33	0	0
1604	2 James I……	22	0	37	4	0	1	10	0	35	14	0	35	14	0
1626	2 Charles I….	—	—	41	0	0	1	1	5	39	18	7	39	18	7
†1666	18 Charles II…	—	—	44	10	0	0	0	0	44	10	0	44	10	0
1717	3 George I….	—	—	46	14	6	0	0	0	46	14	6	46	14	6
1816	56 George III..	—	—	46	14	6	0	0	0	46	14	6	46	14	6

* 1527—Henry VIII.] The Saxon or Tower-pound was used at the mint up to this time, when the pound Troy was substituted in its stead. The Tower-pound was but 11 oz. 5 dwts. Troy; so that, from the Conquest to the 28th of Edward I., twenty shillings in tale were exactly a pound in weight.

† 1666—18 Charles II.] The seignorage on the coinage was at this time given up, and the gold bullion brought to the mint has ever since been coined free of expence. A seignorage of $6\frac{14}{31}$ *per cent.* was imposed on the coinage of silver by 56th Geo. III.

No. II. English Money.—*Account of the Quantity of Fine Silver coined into 20s. or the Pound Sterling; the Quantity of Standard Silver, of 11 oz. 2 dwts. fine, and 18 dwts. alloy, contained in 20s. or the Pound Sterling, and the Quantity of Standard Silver which was delivered to the Mint, by the Public, for 20s. of Silver Money, in the different Reigns, from the time of Edward I. to the Reign of George III.—A similar Account with respect to Gold.—And an Account of the proportionate Value of Fine Gold to Fine Silver, according to the number of Grains contained in the Coins; and the proportionate Value of Fine Gold to Fine Silver, according to the Price paid by the Mint to the Public.*—Calculated in Grains, and 1000 Parts, Troy-weight.

A. D.	Anno Regni.	SILVER. 1. Number of Grains of Fine Silver in 20 Shillings, or the £ Sterling, as coined by the Mint Indentures.	SILVER. 2. Number of Grains of Standard Silver, 11 oz. 2 dwts. fine in 20 Shillings, or the £ Sterling, as coined by the Mint Indentures.	SILVER. 3. Number of Grains of Standard Silver which 20s. were worth, according to the Price paid by the Mint to the Public.	GOLD. 4. Number of Grains of Fine Gold in 20 Shillings, or the £ Sterling, as coined by the Mint Indentures.	GOLD. 5. Number of Grains of Standard Gold, 22 carats fine in 20s. or the £ Sterling, as coined by the Mint Indentures.	GOLD. 6. Number of Grains of Standard Gold which 20 Shillings were worth according to the Price paid by the Mint to the Public.	7. Proportionate Value of Fine Gold to Fine Silver, according to the quantity of each Metal contained in the Coins.	8. Proportionate Value of Fine Gold to Fine Silver, according to the Mint Price, or the presumed Market-value of Gold and Silver.
		Grains.	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Gold to Silver.*	*Gold to Silver.*
1066	Conquest	4995,000	5400,000	....	....	....	....	....	....
1280	8 Edward I....	4995,000	5400,000	5684,210	....	....	....	....	....
1344	18 Edward III.	4933,333	5333,333	5684,210	407,990	445,080	459,625	1 to 12,091	1 to 12,479
1349	23 ———	4440,000	4800,000	5082,352	383,705	418 588	436,777	1 — 11,571	1 — 11,741
1356	30 ———	3996,000	4320,000	4468,965	358,125	390,682	399,561	1 — 11,158	1 — 11,286
1401	3 Henry IV.	3996,000	4320,000	4468,965	358,125	390,682	397,303	1 — 11,158	1 — 11,350
1421	9 Henry V.	3330,000	3600,000	3724,137	322,312	351,613	356,963	1 — 10,331	1 — 10,527
1461	4 Edward IV.	2664,000	2880,000	3272,727	257,850	281,291	319,648	1 — 10,331	1 — 10,331
1465	5 ———	2664,000	2880,000	3272,727	238,750	260,454	273,109	1 — 11,158	1 — 11,985
1470	49 Henry VI.	2564,000	2880,000	3042,253	238,750	260,454	268,202	1 — 11,158	1 — 11,446
1482	22 Edward IV.	2664,000	2880,000	3000,000	238,750	260,454	264,869	1 — 11,158	1 — 11,429
1509	1 Henry VIII.	2664,000	2880,000	2958,901	238,750	260,454	261,909	1 — 11,158	1 — 11,400
1527	18 ———	2368,000	2560,000	2618,181	210,149	229,253	230,630	1 — 11,268	1 — 11,455
1543	34 ———	2000,000	2162,162	2594,594	191,666	209,090	218,181	1 — 10,434	1 — 12,000
1545	36 ———	1200,000	1297,297	2223,938	176,000	192,000	209,454	1 — 6,818	1 — 10,714
1546	37 ———	800,000	864,864	2075,675	160,000	174,545	209,454	1 — 5,000	1 — 10,000
1547	1 Edward VI.	800,000	864,864	2075,675	160,000	174,545	183,732	1 — 5,000	1 — 11,400
1549	3 ———	800,000	864,864	1945,945	155,294	169,412	174,545	1 — 5,151	1 — 11,250
*1551	5 ———	400,000	....	....	....	....	....	....	....
———	———	1760,000	1902,702	....	160,000	174,545	....	1 — 11,000	....
1552	6 ———	1768,000	1911,351	1943,757	160 000	174,545	175,342	1 — 11,050	1 — 11,186
1553	1 Mary.........	1760,000	1902,702	1935,050	159,166	173,636	174,369	1 — 11,057	1 — 11,198
1560	2 Elizabeth ...	1776,000	1920,000	1969,230	160,000	174,545	175,609	1 — 11,100	1 — 11,315
1600	43 ———	1718,709	1858,064	1920,000	157,612	171,940	174,545	1 — 10,904	1 — 11,100
1604	2 James I.	1718,709	1858,064	1936,134	141,935	154,838	161,344	1 — 12,109	1 — 12,109
1626	2 Charles I. ...	1718,709	1858,064	1920,000	128,780	140,487	144,255	1 — 13,346	1 — 13,431
1666	18 Charles II.	1718,709	1858,064	1858,064	118,651	129,438	129,438	1 — 14,485	1 — 14,485
1717	3 George I....	1718,709	1858,064	1858,064	113,001	123,274	123,274	1 — 15,209	1 — 15,209
†1816	56 George III.	1614,545	1745,454	....	113,001	123,274	123,274	1 — 14,287	....

* 1551—5 Edward VI.] The coinage of debased silver money in the 5th year of Edward VI. of 3 oz. fine, ought more properly to be considered as Tokens. The sum of L.120,000 only was so coined. (See James's *Essays*, Chap. IV.)

† 1816—56 George III.] The Government having taken the coinage of silver into its own hands, there is at present no fixed price paid to the public, by the mint, for standard silver. And supposing the Government to continue the present mint regulations, and to keep gold at 77s. 10½d. an ounce, as the price of silver varies, the relative value of gold to silver will vary in like proportion.

No. III. Scots Money.—*Account of the Number of Pounds, Shillings, and Pennies Scots, which have been coined out of One Pound Weight of Silver, at different times; with the degree of Purity of such Silver, or its Fineness, from the year* 1107 *to the year* 1601. (*From Cardonnel's* Numismata Scotiæ, p. 24.)

A. D.	Anno Regni.		Purity.		Alloy.		Value of the Money coined out of a lb. weight of Silver.		
			oz.	pw.	oz.	pw.	L.	s.	d.
From 1107 To 1296	Alexander I. David I. William Alexander II. Alexander III. John Baliol		11	2	0	18	1	0	0
From 1306 To 1329	Robert I.		11	2	0	18	1	1	0
1366	David II.	38	11	2	0	18	1	5	0
1367		39	11	2	0	18	1	9	4
From 1371 To 1390	Robert II.		11	2	0	18	1	9	4
1393	Robert III.	4	11	2	0	18	1	12	0
1421	James I.	19	11	2	0	18	1	17	6
1451	James II.	15	11	2	0	18	3	4	0
1456		20	11	2	0	18	4	16	0
1475	James III.	16	11	2	0	18	7	4	0
1484		24	11	2	0	18	7	0	0
1488 1489	James IV.	1 2	11	2	0	18	7	0	0
1529	James V.	16	11	0	1	0	9	12	0
1544	Mary	3	11	0	1	0	9	12	0
1556		14	11	0	1	0	13	0	0
1565		23	11	0	1	0	18	0	0
1567	James VI.	1	11	0	1	0	18	0	0
1571		5	9	0	3	0	16	14	0
1576		10	8	0	4	0	16	14	0
1579		13	11	0	1	0	22	0	0
1581		15	11	0	1	0	24	0	0
1597		31	11	0	1	0	30	0	0
1601		35	11	0	1	0	36	0	0

No. IV. Scots Money.—*Account of the Number of Pounds, Shillings, and Pennies Scots, which have been coined out of One Pound Weight of Gold; with the degree of their Purity, and the Proportion that the Gold bore to the Silver.* (*Cardonnel*, p. 25.)

A. D.	Anno Regni.		Fineness.			Alloy.			Value of the Coin coined out of One Pound of Gold.			Pound of Pure Gold weighed of Pure Silver.			
			oz.	pw.	gr.	oz.	pw.	gr.	L.	s.	d.	lb.	oz.	pw.	gr.
1371, &c.	Robert II.		11	18	18	0	1	6	17	12	0	11	1	17	22
1390, &c.	Robert III.		11	18	18	0	1	6	19	4	0	11	1	17	22
1424	James I.	19	11	18	18	0	1	6	22	10	0	11	1	17	22
1451	James II.	15	11	18	18	0	1	6	33	6	0	9	8	4	14
1456		20	11	18	18	0	1	6	50	0	0	9	8	4	14
1475	James III.	16	11	18	18	0	1	6	78	15	0	10	2	0	20
1484		21	11	18	18	0	1	6	78	15	0	10	5	7	9
1488	James IV.	1	11	18	18	0	1	6	78	15	0	10	5	7	9
1529	James V.	16	11	18	18	0	1	6	108	0	0	10	5	7	9
1556	Mary	14	11	0	0	1	0	0	144	0	0	10	5	8	6
1577	James VI.	10	11	0	0	1	0	0	240	0	0	10	5	8	6
1579		13	10	10	0	1	10	0	240	0	0	11	5	2	20
1597		31	11	0	0	1	0	0	360	0	0	12	0	0	0
1601		35	11	0	0	1	0	0	432	0	0	12	0	0	0
1633	Charles I.	9	11	0	0	1	0	0	192	0	0	13	2	7	11

No. V. English Paper Money.—*Account of the average Market Price of Bullion in every year, from* 1800 *to* 1821 (*taken from Papers laid before the House of Commons*), *of the average Value* per cent. *of the Paper Currency, estimated from the Market Price of Gold for the same period, and of the average Depreciation of the Paper Currency.*

Years.	Average Price of Gold *per* Ounce.			Average *per cent.* of the Value of the Currency.			Average Depreciation *per cent.*			Years.	Average Price of Gold *per* Ounce.			Average *per cent.* of the Value of the Currency.			Average Depreciation *per cent.*		
	L.	s.	d.	L.	s.	d.	L.	s.	d.		L.	s.	d.	L.	s.	d.	L.	s.	d.
1800	3	17	10½	100	0	0		Nil.		1811	4	4	6	92	3	2	7	16	10
1801	4	5	0	91	12	4	8	7	8	1812	4	15	6	79	5	3	20	14	9
1802	4	4	0	92	14	2	7	5	10	1813	5	1	0	77	2	0	22	18	0
1803	4	0	0	97	6	10	2	13	2	1814	5	4	0	74	17	6	25	2	6
1804	4	0	0	97	6	10	2	13	2	1815	4	13	6	83	5	9	16	14	3
1805	4	0	0	97	6	10	2	13	2	1816	4	13	6	83	5	9	16	14	3
1806	4	0	0	97	6	10	2	13	2	1817	4	0	0	97	6	10	2	13	2
1807	4	0	0	97	6	10	2	13	2	1818	4	0	0	97	6	10	2	13	2
1808	4	0	0	97	6	10	2	13	2	1819	4	1	6	95	11	0	4	9	0
1809	4	0	0	97	6	10	2	13	2	1820	3	19	11	97	8	0	2	12	0
1810	4	10	0	86	10	6	13	9	6	1821	3	17	10	00	0	0		Nil.	

Tables. No. VI. Gold Coins of different Countries.—*A Table containing the Assays, Weights, and Values of the principal* Gold Coins *of all Countries, computed according to the Mint Price of Gold in England, and from Assays made both at London and Paris, which have been found to verify each other.* * Tables.

Table from the Proprietors of the Second Edition of Dr Kelly's Cambist, *where it originally appeared.*

		Assay.			Weight.		Standard Weight.			Contents in Pure Gold.	Value in Sterling.	
			car.	*gr.*	*dwt.*	*gr.*	*dwt.*	*gr.*	*mi.*	*grains.*	*s.*	*d.*
Austrian Dominions	Souverain	W.	0	0¼	3	14	3	13	15	78, 6	13	10,92
	Double Ducat	B.	1	2¾	4	12	4	20	5	106, 4	18	9,97
	Ducat Kremnitz, or Hungarian	B.	1	3	2	5¾	2	10	3	53, 3	9	5,91
Bavaria	Carolin	W.	3	2	6	5¼	5	5	10	115,	20	4,23
	Max d'or, or Maximilian	W.	3	2¼	4	4	3	14	6	77,	13	7,44
	Ducat	B.	1	2¼	2	5¾	2	19	11	52, 8	9	4,12
Bern	Ducat (double, &c. in proportion)	B.	1	1¾	1	23	2	2	1	45, 9	8	1,48
	Pistole	W.	0	1½	4	21	4	19	0	105, 5	18	7,86
Brunswick	Pistole (double in proportion)	W.	0	1½	4	21¼	4	19	5	105, 7	18	8,48
	Ducat	B.	1	0½	2	5¾	2	8	9	51, 8	9	2
Cologne	Ducat	B.	1	2	2	5¾	2	9	8	52, 6	9	3,70
Denmark	Ducat current	W.	0	3¾	2	0	1	21	19	42, 2	7	5,62
	Ducat specie	B.	1	2	2	5¾	2	9	8	52, 6	9	3,70
	Christian d'or	W.	0	1	4	7	4	5	16	93, 3	16	6,14
England	Guinea	Stand.			5	9½	5	9	10	118, 7	21	0
	Half-Guinea	Stand.			2	16¾	2	16	15	59, 3	10	6
	Seven Shilling Piece	Stand.			1	19	1	19	0	39, 6	7	0
	Sovereign	Stand.			5	3¼	5	3	5	113, 1	20	0
France	Double Louis (coined before 1786)	W.	0	2	10	11	10	5	6	224, 9	39	9,64
	Louis	W.	0	2	5	5½	5	2	12	112, 4	19	10,71
	Double Louis (coined since 1786)	W.	0	1½	9	20	9	15	19	212, 6	37	7,53
	Louis	W.	0	1½	4	22	4	19	19	106, 3	18	9,75
	Double Napoleon, or piece of 40 francs	W.	0	1¾	8	7	8	3	0	179,	31	8,36
	Napoleon, or piece of 20 francs	W.	0	1¾	4	3½	4	1	10	89, 7	15	10,5
	New Louis (double, &c.) the same as the Napoleon											
Francfort on the Maine	Ducat	B.	1	2½	2	5¾	2	9	14	52, 9	9	4,31
Geneva	Pistole, old	W.	0	2	4	7¼	4	4	18	92, 5	16	4,45
	Pistole, new	W.	0	0½	3	15¾	3	15	4	80,	14	1,9
Genoa	Sequin	B.	1	3½	2	5¾	2	10	6	53, 4	9	5,41
Hamburgh	Ducat (double in proportion)	B.	1	2½	2	5¾	2	9	14	52, 9	9	4,35
Hanover	George d'or	W.	0	1¼	4	6½	4	5	3	92, 6	16	4,66
	Ducat	B.	1	3¼	2	5¾	2	10	3	53, 3	9	5,19
	Gold florin (double in proportion)	W.	3	0½	2	2	1	18	6	39,	6	10,83
Holland	Double ryder	Stand.			12	21	12	21	0	283, 2	50	1,46
	Ryder	Stand.			6	9	6	9	0	140, 2	24	9,75
	Ducat	B.	1	2¼	2	5¾	2	9	12	52, 8	9	4,13
Malta	Double Louis	W.	1	3¼	10	16	9	18	18	215, 3	38	1,25
	Louis	W.	1	3	5	8	4	21	16	108,	19	1,37
	Demi Louis	W.	1	2¼	2	16	2	11	3	54, 5	9	7,75

* The London Assays in this Table have been made by Robert Bingley, Esq. F. R. S. the King's Assay Master of the Mint, and those at Paris by Pierre Frederic Bonneville, Essayeur du Commerce, as published in his elaborate work on the coins of all nations.

Specimens of all the foreign coins brought to London for commercial purposes have been supplied for this Table from the Bullion-Office, Bank of England, by order of the Bank Directors, and have been selected by John Humble, Esq., the chief of that office, who also examined the tables in their progress. It may likewise be added, that the Mint Reports of these commercial coins are chiefly from average assays; and that all the computations have been carefully verified by different calculators. (Note by Dr Kelly, to second edition of the *Cambist,* published in 1821.)

		Assay.			Weight.		Standard Weight.			Contents in Pure Gold.	Value in Sterling	
			car.	gr.	dwt.	gr.	dwt.	gr.	mi.	grains.	s.	d.
Milan	Sequin	B.	1	3	2	5¼	2	10	0	53, 2	9	4,98
	Doppia or pistole	W.	0	1	4	[illegible]	4	0	8	88, 4	15	7,74
	40 Lire piece of 1808	W.	0	1¼	8	6	8	4	0	179, 7	31	9,64
Naples	Six ducat piece of 1783	W.	0	2¼	5	16	5	12	18	121, 9	21	6,89
	Two ducat piece, or sequin, of 1762	W.	1	2¼	1	20¼	1	16	6	37, 4	6	7,42
	Three ducat piece, or oncetta, of 1818	B.	1	3½	2	10¼	2	15	1	58, 1	10	3,40
Netherlands	Gold lion, or 14 florin piece	Stand.			5	7¼	5	7	16	117, 1	20	8,69
	Ten florin piece (1820)	W.	0	1¼	4	7¾	4	5	15	93, 2	16	5,93
Parma	Quadruple pistole (double in proportion)	W.	1	0	18	9	17	12	18	[illegible]86,	68	3,78
	Pistole or doppia of 1787*	W.	0	3	4	14	4	10	4	97, 4	17	2,85
	Ditto of 1796	W.	1	0¼	4	14	4	8	14	95, 9	16	11,67
	Maria Theresa (1818)	W	0	1¼	4	3½	4	1	10	89, 7	15	10,5
Piedmont	Pistole coined since 1785 (½, &c. in prop.)	W	0	1¼	5	20	5	17	0	125, 6	22	2,75
	Sequin (½ in proportion)	B.	1	2½	2	5¾	2	9	12	52, 9	9	4,34
	Carlino, coined since 1785 (½, &c. in prop.)	W.	0	1¼	29	6	28	20	0	634, 4	112	3,33
	Piece of 20 francs, called *Marengo*	W.	2	0	4	3¼	3	18	4	82, 7	14	7,63
Poland	Ducat	B.	1	2½	2	5¾	2	9	12	52, 9	9	4,34
Portugal	Dobraon of 24,000 rees	Stand.			34	12	34	12	0	759,	134	5,96
	Dobra of 12,800 rees	Stand.			18	6	18	6	0	401, 5	71	0,70
	Moidore or lisbonnine (½, &c. in prop.)	Stand.			6	22	6	22	0	152, 2	26	11,24
	Piece of 16 testoons, or 1600 rees	W.	0	0¼	2	6	2	5	14	49, 5	8	8,70
	Old crusado of 400 rees	W.	0	0½	0	15	0	14	18	13, 6	2	4,85
	New crusado of 480 rees	W.	0	0¼	0	16¼	0	16	2	14, 8	2	7,45
	Milree (coined for the African Colonies 1755)	Stand.			0	19¼	0	19	15	18, 1	3	2,44
Prussia	Ducat of 1748	B.	1	2½	2	5¾	2	9	11	52, 9	9	4,31
	Ducat of 1787	B.	1	2	2	5¼	2	9	6	52, 6	9	3,71
	Frederick (double) of 1769	W.	0	1¼	8	14	8	9	18	185,	32	8,90
	Frederick (single) of 1778	W.	0	1½	4	7	4	5	4	92, 8	16	5,08
	Frederick (double) of 1800	W	0	2	8	14	8	9	6	184, 5	32	7,84
	Frederick (single) of 1800	W.	0	2	4	7	4	4	15	92, 2	16	3,42
Rome	Sequin (coined since 1760)	B.	1	3½	2	4¼	2	9	0	52, 2	9	2,86
	Scudo of the Republic	W.	0	1¼	17	0¼	16	16	6	367,	61	11,13
Russia	Ducat of 1796	B.	1	2½	2	6	2	10	0	53, 2	9	4,98
	Ducat of 1763	B.	1	2	2	5¼	2	9	8	52, 6	9	3,71
	Gold ruble of 1756	Stand.			1	0¼	1	0	10	22, 5	3	11,78
	Ditto of 1799	W.	0	0¼	0	18¾	0	18	14	17, 1	3	0,31
	Gold poltin of 1777	Stand.			0	9	0	9	0	8, 2	1	5,41
	Imperial of 1801	B.	1	2¼	7	17¼	8	6	8	181, 9	32	2,31
	Half imperial of 1801	B.	1	2¼	3	20¼	4	3	4	90, 9	16	1,05
	Ditto of 1818	B	0	0½	4	3¼	4	3	12	91, 3	16	1,98
Sardinia	Carlino (½ in proportion)	W.	0	2¼	10	7½	9	23	16	219, 8	30	8,10
Saxony	Ducat of 1781	B.	1	2	2	5¼	2	9	8	52, 6	9	3,71
	Ducat of 1797	B.	1	2½	2	5¼	2	9	11	52, 9	9	1,34
	Augustus of 1754	W.	0	[illegible]	4	6½	4	3	8	91, 2	16	1,69
	Augustus of 1784	W.	0	1¼	4	6½	4	4	12	92, 2	16	3,81
Sicily*	Ounce of 1751	W.	1	2¼	2	20½	2	15	8	58, 2	10	5,60
	Double ounce of 1758	W.	1	2	5	17	5	7	14	117,	20	8,48
Spain	Doubloon of 1772 (double and single in proportion)	W.	0	2¼	17	8½	61	21	[illegible]	372,	65	10,05
	Quadruple pistole of 1801	W.	1	1	17	9	16	9	[illegible]	[illegible]	63	9,62
	Pistole of 1801	W.	1	1	4	8¼	4	2	[illegible]	90, 1	15	11,35
	Coronilla, gold dol. or vintem of 1801	W.	1	2¼	1	3	1	0	18	22, 8	4	0,42
Sweden	Ducat	B.	1	2	2	5	2	8	12	51, 9	9	2,22
Switzerland	Pistole of the Helvetic Republic of 1800	W.	0	1¼	4	21½	4	19	[illegible]	105, 9	18	8,91
Treves	Ducat	B.	1	2	2	5¼	2	9	8	52, 6	9	3,71
Turkey	Sequin fonducli of Constantinople of 1773	W.	2	2½	2	5¾	1	23	6	43, 3	7	7,94
	Sequin fonducli of 1789	W.	2	3¼	2	5¾	1	22	10	42, 9	7	7,11
	Half misseir (1818)	W.	5	3½	0	18¼	0	13	5	12 10	2	1,82

* Much variation is found in the fineness of the Sicilian gold coins

		Assay			Weight		Standard Weight			Contents in Pure Gold	Value in Sterling	
			car	gr	dwt	gr	dwt	gr	mi	grains	s	d
TURKEY	Sequin fonducli	W.	2	3	2	5	1	22	7	42, 5	7	6,26
	Yermeebeshlek	B	0	$3\frac{1}{2}$	2	$1\frac{3}{4}$	3	4	18	70 3	12	5,30
TUSCANY	Zecchino or sequin	B	1	$3\frac{3}{4}$	3	$5\frac{1}{4}$	2	10	11	53, 6	9	5 8
	Ruspone of the kingdom of Etruria	B	1	$3\frac{7}{8}$	6	$17\frac{1}{4}$	7	7	13	161	28	5 9
UNITED STATES	*Eagle ($\frac{1}{2}$ and $\frac{1}{4}$ in proportion)	W.	0	$0\frac{1}{4}$	11	6	11	4	8	246, 1	48	6,66
VENICE	Zecchino or sequin ($\frac{1}{2}$ and $\frac{1}{4}$ in proportion)	B.	1	$3\frac{1}{4}$	2	6	2	10	10	53, 6	9	5 83
WIRTEMBERG*	Carolin	W.	3	2	6	$5\frac{1}{2}$	5	4	0	113 7	20	1,47
	Ducat	B.	1	2	2	5	2	8	12	51, 9	9	2,22
ZURICH	Ducat (double and $\frac{1}{2}$ ducat in proportion)	B	1	2	2	$5\frac{1}{4}$	2	9	8	52, 6	9	3 71
	EAST INDIES.											
EAST INDIA	Rupee, Bombay (1818)	B	0	$0\frac{1}{2}$	7	11	7	11	18	164, 7	29	1,78
	Rupee of Madras (1818)	Stand			7	12	7	12	0	165,	29	2,42
	Pagoda, Star	W.	3	0	2	$4\frac{3}{4}$	1	21	11	41, 8	7	4,77

No. VII. SILVER COINS OF DIFFERENT COUNTRIES — *A Table containing the Assays, Weights, and Values of the principal* SILVER COINS *of all Countries, computed at the rate of 5s. 2d. per Ounce Standard, from Assays made both at the London and Paris Mints.*

		Assay			Weight		Standard Weight			Contents in Pure Silver	Value in Sterling	
			dwt	gr	dwt	gr	dwt	gr	mi	grains	s	d
AUSTRIA	Rixdollar of Francis II, 1800	W	1	5	18	1	16	0	1	355, 5	4	1,64
	Rixdollar of the kingdom of Hungary	W	1	2	18	1	16	6	1	360, 5	4	2 59
	Half rixdollar or florin, *Convention*	W.	1	3	9	$0\frac{1}{2}$	8	2	1	179 6	2	1,07
	Copftsuck, or 20 creutzer piece	W.	4	3	1	$6\frac{1}{2}$	2	16		59 1	0	8 29
	17 Creutzer piece	W.	4	8	4	0	2	9	18	53 5	0	7 17
	Halbe copf, or 10 creutzer piece	W.	5	5	2	11	1	7	1	28, 8	0	1,01
BADEN	Rixdollar	W	1	4	18	2	16	3	1	8 1	4	2
BAVARIA	Rixdollar of 1800 ($\frac{1}{2}$ in proportion)	W	1	11	17	12	15	13	1	315, 6	4	0,27
	Copftsuck	W	4	5	1	61	2	16	5	59 1	0	8 20
BERN	Patagon or crown ($\frac{1}{2}$ in proportion)	W	0	7	18	22	18	7	14	406 7	1	8 79
	Piece of 10 Batzen	W	1	2	5	3	4	11	17	102 5	1	2 1
BREMEN	Piece of 48 Grotes	W.	2	2	11	0	8	22	1	198	2	3 61
BRUNSWICK	Rixdollar, *Convention*	W	1	3	18	1	16	4	4	359, 6	1	2 15
	Half rixdollar	W	1	3	9	01	8	2	2	179, 6	2	1 07
	Gulden, or piece of $\frac{2}{3}$, fine, of 1764	B	0	16	8	$10\frac{1}{2}$	9	1	1	200, 8	2	1 03
	Gulden, common, of 1764	W	1	2	9	0	8	2	10	180,	2	1,15
	Gulden, ditto, of 1795	W	2	2	11	12	8	23	7	199, 1	2	3 80
	Half gulden, or piece of $\frac{1}{3}$, of 1764	W.	1	2	4	12	4	1	5	90,	1	0 56
DENMARK	Ryksdaler, specie, of 1798	W.	0	15	18	14	17	11	17	388, 4	4	6,2
	New piece of 4 marks	W	0	12	12	9	11	16	14	259, 8	3	0 27
	Half ryksdaler	W.	0	13	9	7	8	17	8	194, 2	2	11
	Mark, specie, or $\frac{1}{7}$ ryksdaler	W	3	1	4	0	2	21	12	64, 4	0	7,59
	Rixdollar, specie, of Sleswig and Holstein (pieces of $\frac{2}{3}$ and $\frac{1}{3}$ in prop.)	W	0	12	18	13	17	12	6	389, 4	4	6,57
	Piece of 24 skillings	W	4	7	5	$2\frac{1}{2}$	3	2	10	68, 9	0	9,62
ENGLAND	Crown (*old*)	Stand.			19	$8\frac{1}{2}$	19	8	10	429, 7	5	0
	Half-crown	Stand.			9	$16\frac{1}{4}$	9	16	5	214, 8	2	6
	Shilling	Stand.			3	21	3	21	0	85, 9	1	0
	Sixpence	Stand			1	$22\frac{1}{2}$	1	22	10	42, 9	0	6
	Crown (*new*)	Stand			18	$4\frac{1}{4}$	18	4	7	403, 6	4	8,36
	Half-crown	Stand.			9	2	9	2	4	201, 8	2	4,18
	Shilling	Stand.			3	$15\frac{1}{4}$	3	15	6	80, 7	0	11,27
	Sixpence	Stand.			1	$19\frac{3}{4}$	1	19	14	40, 3	0	5,63

* This value of the American Eagle is taken from average assays of the coins of twelve years.

		Assay.			Weight.		Standard Weight.			Contents in Pure Silver.	Value in Sterling.	
			oz.	dwt.	dwt.	gr.	dwt.	gr.	mi.	grains.	s.	d.
FRANCE	Ecu of 6 livres	W.	0	7	18	18	18	7	16	408, 1	4	8,28
	Demi ecu	W.	0	7	9	9	9	1	18	204, 5	2	4,13
	Piece of 24 sous (divisions in proportion)	W.	0	7	3	20	8	16	19	83, 4	0	11,64
	Piece of 30 sous (½ in proportion)	W.	3	8	6	12	4	12	4	100, 2	1	1,99
	Piece of 5 francs of the Convention	W.	0	10½	16	0	15	5	14	338, 3	3	11,24
	Piece of 5 francs (Napoleon) of 1808	W.	0	7	16	1	15	12	4	344, 9	4	0,16
	Piece of 2 francs of 1808	W.	0	7	6	11	6	6	2	138, 8	1	7,38
	Franc of 1809	W.	0	7	3	5½	3	3	1	69, 4	0	9,69
	Demi franc	W.	0	8½	1	15	4	13	6	34, 7	0	4,84
	Franc (Louis) of 1818, same as franc of 1809											
GENEVA	Patagon	W.	1	0	17	9	15	19	8	351,	4	1,03
	Piece of 15 sous of 1794	W.	2	6	2	1¼	1	15	1	36, 1	0	5,04
GENOA	Scudo, of 8 lire, of 1796 (½, ¼, &c. in proportion)	W.	0	8	21	9	20	14	10	457, 4	5	3,87
	Scudo of the Ligurian Republic	W.	0	9½	21	9	20	11	2	451, 3	5	3,43
HAMBURGH	Rixdollar, specie	W.	0	10	18	18	17	21	12	397, 5	4	7,49
	Double mark or 32 schillings piece (single in proportion)	W.	2	3	11	18	9	11	8	210, 3	2	5,36
	Piece of 8 schillings	W.	3	12	3	8¼	2	6	4	50, 1	0	6,99
	Piece of 4 schillings	W.	4	6	2	2	1	6	12	28, 3	0	3,95
HANOVER	Rixdollar, *Constitution*	W.	0	9	18	19	18	0	14	400, 3	4	7,89
	Florin, or piece of ⅔, fine	B.	0	16	8	10	9	0	10	200, 3	2	3,96
	Half florin, or piece of ⅓, ditto	B.	0	16	4	4	4	11	4	99, 2	1	1,85
	Quarter, or piece of 6 good groschen, do.	B.	0	16	2	1	2	4	10	48, 6	0	6,78
	Florin, or piece of ⅔, base	W.	2	1	11	0¾	8	23	15	199, 6	2	3,87
HESSE CASSEL	Rixdollar, *Convention*	W.	1	6	18	1	15	22	6	353,	4	1,39
	Florin or piece of ⅔ (½ in proportion)	W.	1	6	9	0½	7	23	3	176, 8	2	0,68
	Thaler of 1789	W.	0	10½	12	7¼	11	17	5	259, 7	3	0,26
	Ecu *Convention* (1815)	W.	1	6	17	23¼	15	21	2	349, 3	4	0,77
	Bon Gros	W.	6	14	1	4	0	11	5	10, 3	0	1,43
HOLLAND	Ducatoon	B.	0	3	20	22	21	4	15	471, 6	5	5,8
	Piece of 3 florins	W.	0	2	20	7	20	2	12	446, 4	5	2,33
	Rixdollar (the assay varies)	W.	0	16	18	6	16	20	8	375, 9	4	4,99
	Half rixdollar	W.	0	16	9	0	8	8	8	185, 4	2	1,89
	Florin or guilder (½ in proportion)	W.	0	4½	6	18	6	14	14	146, 8	1	8,49
	12 Stiver piece	W.	0	16½	4	12	4	3	18	92, 1	1	0,90
	Florin of Batavia	W.	0	5½	6	13	6	9	2	111, 6	1	[illegible],77
	Rixdollar, or 50 stiver piece of the kingdom of Holland	W.	0	5½	17	0	16	13	18	367, 9	4	3,37
LUBEC	Rixdollar, specie	W.	0	13	18	8	17	15	12	391, 9	4	6,72
	Double mark	W.	2	3	11	18	9	11	8	210, 3	2	5,36
	Mark	W.	2	3	5	21	4	17	14	105, 1	1	2,67
LUCCA	Scudo	W.	0	3	17	0	16	18	10	372, 3	4	3,98
	Barbone	W.	3	3	1	20¼	1	7	14	29, 3	0	4,09
MALTA	Ounce of 30 tari of Emmanuel Pinto	W.	2	5	19	1½	15	4	14	337, 4	3	11,11
	2 Tari piece	W.	2	19	1	2	0	19	2	17, 7	0	2,47
MILAN	Scudo of 6 lire (½ in proportion)	W.	0	7	14	20¾	14	9	10	319, 6	3	8,62
	Lira, new	W.	4	10	4	0	2	9	0	52, 8	0	7,37
	Lira, old	W.	0	3	2	10	2	9	4	52, 9	0	7,38
	Scudo of the Cisalpine Republic	W.	0	7	14	21½	14	10	4	320, 2	3	8,71
	Piece of 30 soldi of ditto	W.	2	18	4	17	3	11	8	77, 2	0	10,78
MODENA	Scudo of 15 lire, 1739 (double, &c. in pro.)	W.	0	11	18	12½	17	8	9	385, 2	4	5,78
	Scudo of 5 lire, of 1782	W.	0	3	5	19	5	17	2	126, 8	1	5,70
	Scudo of 1796	W.	3	3	18	1¼	12	22	12	287, 4	3	4,13
NAPLES	Ducat, new (½ in proportion)	W.	1	0	14	15	13	7	8	295, 4	3	5,24
	Piece of 12 Carlini of 1791	W.	1	0	17	15	16	0	18	356,	4	1,71
	Ditto of 1796	W.	1	2	17	16¾	15	22	12	353, 9	4	1,41
	Ditto of 1805 (½ in proportion)	W.	1	2	17	18¼	15	23	18	355, 2	4	1,60
	Ditto of 10 Carlini (1818)	W.	1	2	14	18	13	7	0	295, 1	3	5,20
NETHERLANDS	Ducatoon, old	B.	0	4	21	0	21	9	0	474, 6	5	6,27

Tables.

		Assay.			Weight.		Standard Weight.			Contents in Pure Silver.	Value in Sterling.	
			oz.	dwt.	dwt.	gr.	dwt.	gr.	mi.	grains.	s.	d.
NETHERLANDS	Ducatoon of Maria Theresa .	W.	0	14	21	10	20	1	12	445, 5	5	2,20
	Crown ([illegible] &c. in proportion) .	W.	0	14	19	0	17	19	4	395, 2	4	7,18
	5 Stiver piece . . .	W.	6	3	3	4	1	9	18	31, 3	0	4,37
	Florin of 1790 . .	W.	0	14	5	23½	5	14	9	124, 3	1	5,35
	Florin of 1816 . . .	W.	0	7½	6	22	6	16	6	148, 4	1	8,72
	Half florin (with divisions in proportion)	W.	4	5½	5	11	[illegible]	9	2	75,	0	10,46
PARMA .	Ducat of 1784 . .	W.	0	9	16	11	15	18	18	350, 6	4	0,95
	Ducat of 1796 (½ in proportion) .	W.	0	5½	16	12¾	16	2	18	357, 9	4	1,97
	Piece of 3 lire . . .	W.	1	4	4	14	4	2	2	90, 7	1	0,66
PIEDMONT .	Scudo (1755) ½, &c. in proportion .	W.	0	5½	22	14	22	0	10	488, 9	5	8,26
	Scudo (1770) ½ and ¼ in proportion	W.	0	5	22	14	22	1	16	490, 0	5	8,42
	Piece of 2 lire (1714) . .	W.	0	4½	7	20½	7	16	18	170, 8	1	11,85
	5 Franc piece (1801) . .	W.	0	8	16	1½	15	11	12	343, 7	3	11,99
POLAND .	Rixdollar, old . . .	W.	1	2	18	1	16	6	0	360, 8	4	2,38
	Rixdollar, new (1794) . .	W.	2	17	15	10½	11	11	6	254, 3	2	11,51
	Florin, or gulden . . .	W.	4	2	6	0	3	18	16	84,	0	11,72
PORTUGAL .	New crusado (1690) . . .	W.	0	4	11	0	10	19	0	239, 2	2	9,40
	Ditto (1718) . . .	W.	0	6½	9	8	9	1	0	200, 2	2	3,95
	Ditto (1795) . . .	W.	0	7	9	9	9	1	18	201, 6	2	4,15
	Doze vintems, or piece of 240 rees (1799)	W.	0	7	4	16	4	12	10	100, 4	1	2,01
	Testoon (1799)	W.	0	7	2	0½	1	22	18	43, 4	0	6,06
	New crusado (1809) . . .	W.	0	4	9	3	8	23	0	198, 2	2	4,67
	Seis vintems, or piece of 120 rees (1802)	W.	0	9	2	4½	2	2	8	46, 6	0	6,50
	Testoon (1802) . . .	W.	0	9	2	0	1	22	0	42, 5	0	5,93
	Tres vintems, or piece of 60 rees (1802)	W.	0	9	1	2¼	1	1	4	23, 3	0	3,25
	Half testoon (1802) . . .	W.	0	9	0	23	0	22	0	20, 4	0	2,84
PORTUGUESE COLONIES	Piece of 8 macutes, of Portuguese Africa	W.	0	9	7	12	7	4	14	159, 8	1	10,31
	Ditto of 6 ditto	W.	0	9	5	13	5	7	12	118,	1	4,47
	Ditto of 4 ditto . .	W.	0	9	3	16	3	12	8	78, 1	0	10,90
PRUSSIA .	*Rixdollar, Prussian currency (½ in prop.)	W.	2	5	14	6½	11	9	0	252, 6	2	11,27
	Rixdollar, *Convention* . .	W.	1	3	18	1	16	4	2	359,	4	2,13
	Florin, or piece of ⅔ . . .	W.	2	3	11	2	8	22	8	198, 4	2	3,70
	Florin of Silesia . . .	W.	2	2	9	11	7	16	0	170, 3	1	11,78
	Drittel, or piece of 8 good groschen .	W.	3	3	5	8¾	3	20	4	85, 3	0	11,91
	Piece of 6 groschen . .	W.	2	8	3	14	2	19	6	62, 3	0	8,69
ROME . . .	Scudo, or crown (coined since 1753)	W.	0	4	17	1	16	17	18	371, 5	4	3,87
	Mezzo scudo, or half-crown . .	W.	0	4	8	12½	8	8	16	185, 7	2	1,93
	Testone (1785) . . .	W.	0	5	5	2	4	23	4	110, 3	1	3,40
	Paolo (1785) . . .	W	0	4	1	17	1	16	4	37, 2	0	5,19
	Grosso, or half paolo (1785) . .	W.	0	5	0	20½	0	20	0	18, 5	0	2,58
	Scudo of the Roman Republic (1799)	W.	0	6	17	1	16	13	18	368, 1	4	3,40
RUSSIA . .	Ruble of Peter the Great . .	W.	2	7	18	1	14	1	8	312, 1	3	7,58
	Ditto of Catherine I. (1725) . .	W.	2	4½	17	11	13	23	0	309, 9	3	7,27
	Ditto of Peter II. (1727) . .	W.	2	12	18	5¾	13	23	4	310,	3	7,28
	Ditto of Anne (1731) . .	W.	1	11	16	14½	14	6	16	317, 2	3	8,29
	Ditto of Elizabeth (1750) . .	W.	1	7	16	12	14	11	16	321, 8	3	8,93
	Ditto of Peter III. (1762) . .	W.	2	2	15	10	12	12	0	277, 5	3	2,75
	Ditto of Catherine II. (1780) . .	W.	2	4	15	12	12	10	6	275, 9	3	2,52
	Ditto of Paul (1799) . . .	W.	0	14	13	12	12	15	10	280, 8	3	3,21
	Ditto of Alexander (1802) . .	W.	0	13	13	1½	17	7	2	273,	3	2,12
	Ditto of ditto (1805) . . .	W.	0	16	13	12	12	12	12	278, 1	3	2,83
	20 Copeck piece (1767) . .	W.	2	2	3	10¾	2	19	0	62, 6	0	8,74
	Ditto (1784) . . .	W.	2	2	3	3	2	12	18	56, 2	0	7,84
	15 Copeck piece (1778) . .	W.	2	2	2	6	1	19	18	40, 5	0	5,65
	10 Copeck piece . . .	W.	2	6	2	1	1	14	16	35, 9	0	5,11
	Ditto (1798) . . .	W.	0	14½	1	9	1	6	16	28, 5	0	3,97
	Ditto (1802) . . .	W.	0	13	1	8½	1	6	11	28, 3	0	3,95
	5 Copeck piece (1801) . .	W.	0	13½	0	16½	0	[illegible]	10	15, 3	0	2,13
SARDINIA .	Scudo, or crown (½ and ¼ in proportion)	W.	0	7	15	2½	14	15	0	324, 7	3	9,34

* The Prussian coins, having been debased at different periods, vary in their reports.

		Assay.			Weight.		Standard Weight.			Contents in Pure Silver.	Value in Sterling.	
			oz.	dwt.	dwt.	gr.	dwt.	gr.	mi.	grains.	s.	d.
SAXONY	Rixdollar, *Convention* (½ and ¼ in prop.)	W.	1	3	18	0	16	3	4	358, 2	4	2,01
	Piece of 16 groschen of Leipsic	W.	2	2	9	9½	7	14	16	169, 1	1	11,61
	Rixdollar current of Saxe Gotha	W.	4	4½	18	1	11	4	2	248, 1	2	10,64
	⅙ Thaler of 1804	W.	4	11	3	11	2	0	19	45, 3	0	6,82
	Ditto of 1808	W.	4	11½	3	5½	1	21	8	42, 1	0	5,87
	Ditto of Jerome Buonaparte of 1809	W.	5	4	3	17	1	23	6	43, 7	0	6,10
SICILY	Scudo (½ in proportion)	W.	1	4	17	14	15	16	[illegible]	348, 2	4	0,62
	Piece of 40 grains	W.	1	2	5	21	5	7	2	117, 5	1	4,40
SPAIN	Dollar,* of late coinage	W.	0	8	17	8	16	17	0	370, 9	4	3,79
	Half dollar, ditto	W.	0	8	8	16	8	8	10	185, 4	2	1,88
	Mexican peceta (1774)	W.	0	8	4	7¼	4	3	16	92, 3	1	0,88
	Real of Mexican plate (1775)	W.	0	8	2	3¾	2	1	20	46, 1	0	6,43
	Peceta provincial of 2 reals of new plate (1775)	W.	1	9½	3	18	3	6	0	72, 2	0	10,08
	Real of new plate (1795)	W.	1	9½	1	21	1	15	0	36, 1	0	5,04
SWEDEN	Rixdollar (1762)	W.	0	12	18	20	17	19	10	395, 5	4	7,22
	Rixdollar of late coinage	W.	0	11½	18	17	17	12	0	388, 5	4	6,28
SWITZERLAND	Ecu or rixdollar of Lucerne, ½, &c in proportion (1715)	W.	0	11½	17	8½	16	5	8	360, 1	4	2,28
	Old gulden, or florin of Lucerne (1714)	W.	1	19	8	14½	7	2	8	157, 5	1	9,99
	Ecu of 10 batzen of Lucerne (1796)	W.	0	5	19	0	18	13	14	412, 3	4	9,57
	Half ditto	W.	1	2	9	20	8	20	12	196, 7	2	3,46
	Florin, or piece of 40 schillings of Lucerne (1793)	W.	1	5	4	22	4	8	14	96, 8	1	1,51
	Ecu of 10 batzen of the Helvetic Republic (1798) ½ in proportion	W.	0	6	18	23	18	10	14	409, 5	4	9,18
	Ecu of 4 franken (1801)	W.	0	7	18	23	18	8	12	407, 6	4	9,18
TURKEY	Piastre of Selim of 1801	W.	5	6	8	6	4	7	8	95, 7	1	1,36
	Piastre of Crim Tartary (1778)	W.	6	13	10	5	4	2	4	90, 9	1	0,69
	Piastre of Tunis (1787)	W.	6	5½	10	0	4	8	6	96, 5	1	1 17
	Piastre (1818)	W.	5	14	6	6½	3	1	4	67, 7	0	9,15
TUSCANY	Piece of 10 paoli of the kingdom of Etruria (1801)	W.	0	4	17	13½	17	5	18	382, 9	4	5,46
	Scudo Pisa of ditto (1803)	W.	0	2	17	12	17	8	4	385, 0	4	5,76
	Piece of 10 lire ditto (1803)	B.	0	7	25	6	26	1	12	578, 7	6	8,80
	Lira (1803)	B.	0	7	2	8	2	9	16	53, 4	0	7,45
UNITED STATES	† Dollar (1795) ½, &c. in proportion	W.	0	6½	17	8	16	19	16	373, 5	4	4,15
	Dollar (1798)	W.	0	7	17	10½	16	21	6	374, 9	4	4,35
	Dollar (1802)	W.	0	10½	17	10	16	14	0	368, 8	4	3,42
	Dollar, an average of 8 years	W.	0	8½	17	8	16	16	0	370, 1	4	3,68
	Dime, or one-tenth dollar (1796)	W.	0	4	1	19½	1	18	14	39, 5	0	5,71
	Half dime (1796)	W.	0	7	0	21¾	0	21	6	19, 5	0	2,72
VENICE	Piece of 2 lire, or 24 creutzers (1800)	W.	8	4½	5	19½	1	12	2	33, 4	0	4,66
	Ditto of 2 lire, called moneta provinciale (1808)	W.	8	3	5	13½	1	11	8	32, 8	0	4,58
	Ditto of 2 lire (1802) ½ and ¼ in prop.	W.	8	4	5	6¼	1	8	19	30, 5	0	4,25
WIRTEMBERG	Rixdollar, specie	W.	1	3	18	1	16	14	2	359, 1	4	2,14
	Copftsuck	W.	4	2	4	16½	2	16	12	59, 8	0	8,35
	EAST INDIES.											
EAST INDIA	Rupee of Sicca, coined by the East India Company at Calcutta	B.	0	13	7	11½	7	22	0	175, 8	2	0,54
	.... Calcutta (1818)	Stand.			8	0	8	0	0	175, 9	2	0,56
	.... Bombay, new, or Surat (1818)	W.	0	0¼	7	11	7	10	4	164, 7	1	11,01
	Fanam, Cananore	W.	0	1¼	1	11¾	1	11	10	32, 9	0	4,5
	.... Bombay, old	B.	0	13	1	11¾	1	13	16	35,	0	4,88
	.... Pondicherry	B.	0	5½	1	0½	1	1	2	22, 8	0	3,18
	.... Ditto, double	W.	0	3	1	18¾	1	18	2	39,	0	5,44
	Gulden of the Dutch East India Company (1820)	W.	0	7½	6	22	6	16	6	148, 4	1	8,72

* This is the coin which is universally circulated under the name of the Spanish dollar.

† The American dollars, and inferior silver pieces of late coinage, vary in fineness from W. 4 dwt. to W. 9½ dwt.

Tables || Monmouthshire.

No. VIII.—*Account of the Relative Value of Gold and Silver in the principal Trading Places of the World, computed from the proportional Quantity of Pure Metal, in their principal Coins, and the legal or current Price of those Coins respectively. (Given in by Dr Kelly to the Committee of the House of Lords, appointed, 1819, to inquire into the Expediency of the Bank's resuming Cash Payments.)*

	By Mint Regulations.	By Assays.	Names of the Coins from which the Proportions are taken.
England, By Old Coinage	15,2096 to 1	Proved correct by the Trials of the Pix.	Per Guinea and Old Shilling.
By New Coinage	14,2878 to 1		Per Sovereign and New Shilling.
Amsterdam	15,8735 to 1	——	Per 10 Guilder Piece decreed in 1816, and Silver Florin of the same date.
Hamburgh	15 to 1 nearly	14,83 to 1	Per Ducato reckoned at 6 Marks Banco and Rixdollar.
Paris	15,5 to 1	15,5 to 1	Per 20 Franc Piece and 5 Franc Piece.
Madrid	16 to 1	15,85 / 16,46 to 1	Per Doubloon and Dollar of different Coinages.
Lisbon	13,56 to 1	13,33 to 1	Per Joannese and New Silver Crusado.
Leghorn	14,65 to 1	14,32 to 1	Per Ruspono and Francescone.
Genoa.	15,34 to 1	15,35 to 1	Per Genovina and Scudo.
Naples	15,21 to 1	——	Per Oncetta and Ducato. (Coinage of 1818.)
Venice	15 to 1 nearly	14,35 to 1	Per Sequin and Ducat.
Petersburgh	15 to 1 nearly	15,25 to 1	Per Ducat and Ruble.
United States	15 to 1	15,94 to 1	Per Eagle and Dollar.
Bengal	14,857 to 1	14,827 to 1	Per Gold Mohur and Sicca Rupee.
Madras	13,872 to 1	13,857 to 1	Per Star, Pagoda and Current Rupee.
Bombay	15 to 1	15 to 1	Per Gold Rupee and Silver Rupee.
China	14,25 to 1	——	Per Tale of Gold, and the Average Price of Spanish Dollars.

S. S.

MONMOUTHSHIRE, a county of England, which, before the year 1535, was a portion of the principality of Wales. It is now no longer under the jurisdiction of the Welsh Judges, but it still is so far considered as not an English county, that the causes which are removed for trial from the principality to England are tried within it. The greater part of the inhabitants still speak one of the three dialects of the Welsh language; in some of the churches the worship is exclusively conducted in that tongue, in many it is celebrated in Welsh and English alternately, and only in the towns in English alone.

Boundaries and Extent. Monmouthshire is bounded on the north by Herefordshire, on the east by Gloucestershire, on the south by the river Severn, and on the west by the Welsh counties of Brecon and Glamorgan. Its greatest length is 33 miles, its greatest breadth 26, and its circumference 110 miles. The square extent is 516 miles, or 330,240 acres.

Soil and Face of the Country. The face of the country is highly diversified, exhibiting every gradation from lofty and bleak mountains, to highly verdant and beautiful sequestered vallies. Some of the mountains, as the Sugar-loaf, of 1850 feet, the Blorenge of 1720, and the Skyridvawr of 1498 feet, with some others, display their summits for many months covered with snow, whilst their sides, near the bottom, are cultivated with the different species of grain, and terminate in meadows of the most luxuriant fertility. Mr Fox, in his *Agricultural Survey* of this county, divides it into three districts. The first, comprising the southern division, consists in part of large tracts of moor or marsh land, exhibiting in some parts of it a great depth of unctuous loamy soil, and in others a vast body of black peaty earth. In other parts of this district the soil is of a light loamy consistence, highly favourable to the growth of various trees. Another portion is a mixture of clay and loam, forming fertile meadows, and above them an excellent red soil, in which turnips, potatoes, and grain, liberally repay the cultivator. The second division comprehends the eastern part of the county, extending to a considerable, but varying distance on both sides the river Usk. The soil is of a faint red colour, highly grateful, and being carefully cultivated, the whole displays the appearance of great fertility. The third division comprises the western and most mountainous parts of the county. The soil on the hills is generally of a thin peaty nature, covering strata of stone, underneath which are mines of coal and iron ore, of most unbounded productiveness. The low lands in this division are chiefly in the state of meadow and pasture, whilst the middle lands are occupied partly by pasture and partly by arable husbandry.

The rivers of this county have been generally celebrated for the picturesque scenery which their banks display, and which, added to the many remains of antiquity that are to be seen near them, invite the visits of numerous parties in the summer months, and afford the highest gratification to travellers of taste. The most eminent of these rivers, in beauty as well as Rivers

Monmouthshire.

utility, is the Wye. It rises on the southern side of Plinlimmon, in Montgomeryshire, and forming the division line between the counties of Brecon and Radnor, passes through a part of Herefordshire, and enters this county at Dizon, becomes navigable for boats at Monmouth, and empties itself into the Severn at Chepstow. The beauties of this stream are derived from the sinuosities of its course, the uniformity of its breadth, the picturesque country through which it flows, and, among many other striking objects on its banks, from the Abbey of Tintern, and the mansion and grounds of Piercefield. The tide in this river rises at Chepstow to a greater height than in any other English river; at the bridge of that town the elevation has been between 50 and 60 feet, and it takes place with most unusual celerity. The Usk rises in the black mountains of Brecknockshire, and when it enters this county, passes between lofty hills, which gives its borders every variety of beauty that landscape can display. It is navigable for a short distance, and only for barges. It abounds with salmon, some of which are frequently caught in it of a most unusual size. The other rivers are the Rumney, the Monnow, and the Ebwy, each of which has peculiar and characteristic beauties.

Canals and Rail-roads.

The heavy productions of this county, iron, coal, and limestone, have given rise to the establishment of various canals for their conveyance. The Monmouthshire canal begins at Newport, and dividing into two branches, connects that town, by one, with Pontypool and Pontnewyd, and by the other with Crumlin Bridge. The Brecknockshire canal unites with this, and passes, in its course, under a hill by means of a tunnel 360 feet. The county is most abundantly supplied with rail-roads, leading from the principal mining districts to the canals; and many private mines have small rail-ways, provincially called tram-roads, leading to the principal iron rail-roads, by which a facility is afforded to the conveyance of productions through a country whose roads are eminently bad.

Agriculture.

The agricultural productions are wheat, barley, and oats, with a few pease and beans. They are sufficient for the supply of the inhabitants, and the small surplus, as well as much fruit, is sent to the markets of Bristol. On the arable lands the system of summer fallowing is pretty generally pursued. The principal manure is lime, the stone from which it is burnt being most abundant. The oxen of this county are highly esteemed both for draught and for fattening. They are usually a deep red colour, short in the legs, and compact in the carcase, being a cross between the breeds of Hereford and Glamorgan. They are very docile in harness, and will fatten so as to weigh from seven to nine hundred weight. They are much sought after by the English graziers, who purchase them when young, and after employing them in labour, fatten them for the butcher. The sheep are remarkably small, the wool is short and coarse, but the flesh is fine in the grain, and of a most delicate flavour. Of late years much improvement has been made in the flocks by judicious crosses with the Cotswold, Southdown, and Dorset sheep. The horses of the county are generally a very meagre, light, and uncompact breed. In this county and Brecknockshire the breeding and rearing of mules is carried to a greater extent than in any other part of the island. They are found very beneficial in the hilly districts, where the mines are worked. Male asses are imported from Spain and the south of France, to propagate, and the mules are frequently of a size and strength equal to the natives of those countries.

Live Stock.

Division of Property.

The landed property of this county is in few hands, but divided generally into small farms, varying in rent from L.70 to L.200. The leases are generally for 21 years, and the conduct of the landlords to their tenants is liberal, and somewhat parental. Many farms are held by copy of the court roll.

Mines.

The greatest riches of Monmouthshire are derived from its mines. Coal and iron ore abound in all the hills. The facilities for interior conveyance have been before noticed. The coals of this county have, under the act of Parliament for constructing the canal, the peculiar privilege of being carried to the opposite shore, including the city of Bristol and the towns on that coast, as far as Bridgewater, without paying the water-borne duty. This gives to them a monopoly of those large markets, to the exclusion of the collieries in the forest of Dean, and of Glamorgan and Carmarthenshire. The proprietors of these last mentioned mines have petitioned Parliament to be placed on a similar footing, but, after a most patient investigation of all the circumstances in a committee, the peculiar rights of the coals brought by the Monmouthshire canal were confirmed. The iron mines were worked as early as the reign of Queen Elizabeth, and made a rapid progress; but owing to the great consumption of wood, which soon caused a scarcity of fuel, they had sunk very low till about fifty years ago, when the mode of making iron from coke was introduced. This discovery, with the improvements in machinery, has given a vast impulse to the working the iron mines. Fifteen or sixteen works, on the largest scale, and many smaller ones, have been established. At one period, the weekly delivery of pig-iron and bar-iron from these different works is stated to have amounted to a thousand tons.

Manufactures.

The abundance of iron, and the facility of intercourse with Cornwall, have led to the establishment of some very extensive manufactories of tin plates. The manufactory of a kind of Japan ware was first practised in England by Thomas Allgood of Pontypool, in the reign of Charles the Second; and though the skill of Birmingham has been successfully exerted to rival the town from whence that ware derived its name, the business is still continued there, but upon a small scale. The manufactory of caps, for which Monmouth was celebrated at the period when Shakespeare wrote, has been long abandoned. At Newport and Chepstow there are some considerable establishments for building ships.

Antiquities.

Few parts of the island contain more numerous or better preserved remains of Roman and Saxon antiquity than this county. Caerleon was long the metropolis of the British dominions, and the residence of King Arthur. The ruins of the wall, 530 yards by 480, are still to be traced; and the vast

Monmouthshire.

masses of stones, which are now in a confused state, show that it was formerly a place of great importance. There are many Roman encampments still visible. The remains of the abbeys of Gracedieu, Llantarnam, Llanthony, and Tintern, and of the priories of Goldcliff, Thynemark, Monmouth, and Usk, invite the close examination of antiquarians. The castles of Abergavenny, Carleon, Caldecot, Castell-Glas, Chepstow, Dinham, Grosmont, Llanfair, Scenfrith, Striguil, Usk, and Llandeilo, are the most remarkable among numerous other similar buildings. The character of the architecture of the churches of Abergavenny, Carleon, Caldecot, Chepstow, Newport, and others, discovers a very ancient origin. The antiquities of Monmouthshire would, indeed, require a volume for their delineation.

Civil and Ecclesiastical Affairs.

The county gives the title of Earl of Abergavenny to the family of Neville, not by creation or writ, but as possessors of the castle of that town. The Irish Marquis of Ormond derives from it the title of Baron Butler, and the Duke of Beaufort is Baron Herbert of Chepstow and Rogland, and Baron Beaufort of Caldecot Castle. The members to the House of Commons are two for the county and one for the united boroughs of Monmouth, Newport, and Usk. The whole county is within the diocese of Llandaff, except three parishes, which are in St David's, and three others in that of Hereford. The English Judges, on the Oxford circuit, hold the assizes twice a year at Monmouth.

Divisions and Population.

The county is divided into six hundreds, and contains one hundred and twenty parishes and seven market towns. At the census of 1811, there were returned 12,127 houses, inhabited by 12,518 families. Of these families 5815 were employed in agriculture, 4812 in trade and manufactures, and 1916 in other occupations. The number of inhabitants was 62,127, viz. 30,987 males and 31,140 females. The baptisms of males, the preceding years, were 642, and of females 632. The burials of males were 514, of females 444. The marriages were 416. The towns which contain more than 1000 souls are as follows:

	Houses.	Inhabitants.
Monmouth, - - - -	675	3503
Abergavenny, - - -	575	2815
Ushkawrcod, - -	416	2728
Chepstow, - - - -	429	2581
Trevethin (including Pontypool),	466	2423
Newport, - - - -	445	2346
Aberystwith, - - -	302	1626
Llanofer, - - - -	341	1572
Mamhole, - - -	218	1230
Machen, - - - -	235	1167
Llanwenarth, - - -	241	1138
Mynydd-maen, - - -	194	1098
Panteague, - - -	212	1052
Penmaen, - - -	205	1010

The seats of noblemen and gentlemen within the county are very numerous; the most remarkable are, Troyhouse, Duke of Beaufort; Bix Weir, General Rooke; Courtfield, William Vaughan, Esq.; Coldbrook, J. H. Williams, Esq.; Dynastow Court, Samuel Bosanquet, Esq.; Kesneyshouse, L. Lord, Esq.; Llanarth Court, John Jones, Esq.; Llanofer, Benjamin Waddington, Esq.; Llanvitsangle, Earl of Oxford; Mamheled, W. Morgan, Esq.; Mayndec, Sir Robert Kemeys; Pen Park, — Williams, Esq.; Piercefield, Nathaniel Wells, Esq.; Pont y Pool, C. H. Leigh, Esq.; Tredgar, Sir Charles Morgan, Bart.; Trewyn, J. Rosier, Esq.; Wynastow Court, Thomas Swinnerton, Esq.

See Coxe's *Historical Tour in Monmouthshire; History of Monmouthshire*, by David Williams; Donovan's *Descriptive Excursions through South Wales and Monmouthshire;* Strange's *Roman Antiquities at Caerleon and Caerwent;* Fox's *General View of the Agriculture of Monmouthshire.* (W. W.)

Monmouthshire || Montgomeryshire.

Boundaries and Extent.

MONTGOMERYSHIRE, an inland county of North Wales. It is bounded on the east by Shropshire, on the north by Denbighshire and Merionethshire, on the west by Cardiganshire and Merionethshire, and on the south by Radnorshire. It is of an irregular form; its greatest length, from north to south, is thirty-six miles, and its mean breadth, from east to west, is about thirty-two miles. Its area, in square miles, is estimated to be 982, or 620,720 statute acres; but is probably overrated.

Face of the Country.

It is a county of very irregular surface, composed, in the centre, of a ridge of lofty mountains, which nearly divide it, and from which various branches project, which, though not equal in height to the mean ridge, attain a great elevation. The loftiest of the mountains, Plinlimmon, or Pumlumon, is continued through Montgomeryshire and enters Merionethshire; from its centre various streams run, some to the east and some to the west, the former into the Severn, and the latter to the sea at Cardigan bay. Plinlimmon is, at the highest point, 2463 feet above the level of the sea; the other mountains that branch from it are Llandinam, 1898 feet, the Long Mountain 1330, and that on which a pillar, to the memory of Lord Rodney, is erected, 1204. From the irregularity of the surface, and the great elevations, the chief part of the county is bare, raw, and barren; but in the vallies between the mountains, there are some most delightful and fertile spots, watered by translucid rivulets, and bordered with the richest forest scenery.

Rivers, Canals, and Cascades.

The rivers that run westerly from the mountain ridges are the Traeth-bach, the Maw, and the Dovey. The Wye, the Severn, the Vyrnwy, and the Tanat, which receive several smaller mountain torrents, run to the eastward: the two first, which receive the others, keep nearly a parallel course to the plains of Salop. The Severn, though at first a mere mountain rill, and soon a rapid torrent, speedily assumes a tranquil character, and glides through deep vales till it enters Shropshire, and becomes the second of our English rivers. It is the only stream navigable in this county, but it is passable only at periods of rain by boats, and frequently ship timber lies on its banks a long time, waiting for sufficient water to float it down the stream. A canal has been constructed, connected with the Ellesmere canal in Shropshire; but though completed, it is found to be a very unproductive undertaking. There are some picturesque waterfalls, which invite the inspection of travellers in this romantic county. The

ontgomeryshire. most remarkable of these is Pystyll-Rhaïadr. The brook, or rather river Rhaïadr, (for, after rains, it deserves the latter name), runs over a gentle declivity for a short distance, and then suddenly precipitates itself over a perpendicular ledge, from whence it falls, rather in the form of spray than in that of a torrent, to the depth of two hundred feet, while the projecting rocks that intercept its fall cause a spectacle and sounds that are highly terrific. This cataract appears in its grandeur only after a wet season, for in very dry weather it is an insignificant rill.

griculture. The agriculture of Montgomeryshire is in a very backward state; not one-eighth of the land is under the plough; about three-eighths of it is devoted to pasture, but the food it produces is small for the extent on which it grows. Nearly half the county is in an uncultivated state, or covered with wood. Some few good cultivators have of late, in some spots, introduced the Norfolk four course system of turnips, barley, clover, and wheat, but it prevails to a very limited extent, owing to the deficiency of capital among the occupiers. The greater part of the arable land is destined to produce corn, without intermission, till it becomes exhausted, when it returns of itself to a very imperfect and unproductive kind of pasture. Though these remarks refer to the greatest part of the county, yet a part of it adjoining to Shropshire forms a very laudable exception, as it is well cultivated, and very prolific, especially on the banks of the Severn. In almost every part of the county hemp is cultivated for domestic use, in small patches, and the making it into cloth forms the employment of itinerant weavers.

attle. The cows of this county somewhat resemble the Devonshire breed, and are said to have been originally brought from that county. When removed to better pasture, and fattened, they are highly valued by the butchers, because they yield less offal, and collect a greater mass of flesh on the more valuable parts of the body. The sheep are of small size, but their mutton is exquisite. The wool is of very fine quality, and the best Welsh flannels are made from it. There is a very numerous breed of small horses on the mountainous parts of Montgomeryshire, which are nearly in a state of nature. They are known by the name of Merlyns, and range through the whole year over the most elevated parts of the country. By their exposure, and the ease with which they are subsisted, they acquire a very hardy frame, and are capable of performing labour far beyond what their size and apparent strength indicate. They are driven, when needed, into an inclosure, where the best are selected from those that have attained their third year, and the remainder are turned out to range at large as before. Notwithstanding their diminutive size, the greater part of the commodities furnished by the county are conveyed on their backs from one place to another. The vallies in this county have been long celebrated for a breed of excellent horses, introduced originally from the south of Spain, by the Earl of Shrewsbury in the reign of Queen Elizabeth; these, by various crosses, have been much improved, and they now furnish some of the best hunters in the kingdom, from uniting strength with speed.

ime and uel. Limestone is not generally found in this county, and rarely unmixed with argillaceous earth; so that the lime required for building is brought from one extremity to the other by the canal. Coal is only found in an angle of the county, on the borders of Salop; the quantity is small, and its combustive quality causes it to burn so rapidly, as to make it a much more expensive fuel, except in the vicinity of the pits, than either wood or turf.

Minerals. The mineral which abounds most in the mountains of Montgomery is lead, which is raised in many parts of them. The ore known by the name of *galena*, provincially called potters ore, was formerly discovered in a prodigious vein at Llangynnog, but, after much profitable excavation, the miners reached a fault in the vein, and its continuance has not been yet ascertained. At Llanymynach are the vestiges of mines worked in very remote periods, which exhibit intricate recesses, and form a kind of subterraneous labyrinth. Both copper and lead ore are still found in these ancient mines, and zinc, in unison with sulphuric and carbonic acids, known by the common appellations of calamine, and black-jack. A very rich lead mine at Tallessi was formerly worked, and yielded large profits to its owner, Sir Watkins Williams Wynne; but, owing to a great increase of water, the working has been discontinued. The ranges of mountains are partly composed of schist, from which are drawn large quantities of slates, applied to the covering of houses, or sent to London and Bristol, to be fitted for writing.

Timber. This was formerly one of the best wooded counties of North Wales, and it has, for the last seventy years, contributed to supply a great part of the best oak timber to the Royal Dock-yards. The size of the Montgomeryshire oaks has made them much prized for naval purposes; some have been felled which have contained more than 600 cubic feet. This oak is of a remarkably good quality, but the difficulty of conveyance has rendered the price very low on the spots where it is grown, and formerly much of even the most valuable quality was used for fuel.

Manufactures. The only manufactures are of woollens, made from the fleeces of their native sheep, and mostly confined to flannels known through England, and highly prized, under the denomination of *Welsh flannels*. They have been imitated both in Lancashire and Yorkshire, but have not been equalled in fineness of texture, combined with softness. The farmers, and even the cottagers, make these flannels; and they are collected by a kind of middle-men, who bring them to the market of Welshpool, whence they are sold to the merchants of Shrewsbury, who distribute them over the kingdom. The annual value sold at the market is about L. 50,000, and the cost of the wool is estimated at about half that amount.

Two members are returned to Parliament, one for the county, and one for the borough of Montgomery, the county town.

Population. In 1811, the population amounted to 53,700 persons; Welshpool then contained 3440, and Montgomery 932.

The most remarkable seats of noblemen and gentlemen are, Powis Castle, Lord Powis; Lydiarth Hall, Sir W. W. Wynne, Bart.; Llangedwen, Mr Wynne; Towyn, E. Corbet, Esq.; Llandinam, M.

Montgomeryshire || Moore.

Stephens, Esq.; Vayner, Captain Windus; Newton Park, Richard Shaw, Esq.

See Aikin's *Tour in Wales*; Evans's *North Wales*; *Cambrian Itinerary*. (W. W.)

MOORE (JOHN, M. D.) was the son of one of the clergymen of Stirling, where he was born in the year 1730. He received his medical education at the University of Glasgow, and at the early age of seventeen, he served as surgeon's mate with the army in Flanders. After the conclusion of peace, he prosecuted his medical studies at Paris, where he was appointed surgeon to the household of the English Ambassador, Lord Albemarle. On his return to Scotland, he settled as a surgeon at Glasgow; and there he quickly rose to extensive and successful practice. In every period of his life he delighted in social intercourse; and during his residence in Glasgow, his leisure hours were, in a great measure, devoted to the enjoyment of society. His vivacity in conversation, and agreeable turn of wit and humour, attracted around him a numerous and respectable circle of acquaintances. Though he did not at this period come before the public as an author, he often wrote occasional poems on the occurrences of the day, for the amusement of the society which he frequented, and of which he formed the principal charm. His acute and just discrimination of the various shades in the manners and dispositions of mankind was even at this time displayed in a series of verses, characteristic of the members of a convivial club to which he belonged.

In the year 1769 he was called, in his medical capacity, to attend the young Duke of Hamilton, who was labouring under a pulmonary complaint, to which he ultimately fell a victim. His attendance at Hamilton subsequently led to his accompanying the brother of his patient to the continent. An extensive and long continued tour through Italy, France, and Germany, opened a wider range to his faculty of investigating the characters of mankind than he had hitherto enjoyed. After spending five years abroad, he settled as a physician in London; and about the same time commenced his literary career, by publishing the fruits of his travels in his *View of Society and Manners in France, Switzerland, and Germany*. This work was so well received that, in 1781, he added to it two volumes, entitled, *A View of Society and Manners in Italy*. A discriminating observer of the customs, passions, and prejudices of mankind, he was admirably qualified to give a correct and interesting view of society and manners in the countries through which he had travelled; and, by means of the epistolary form which he adopted, he has completely succeeded in giving sufficient connection and animation to his Miscellaneous Anecdotes, his Sketches of Distinguished Men, and his Remarks on National Character. In 1785 he published his *Medical Sketches*, consisting chiefly of observations on the Animal Economy and the treatment of Fevers. His next performance, which appeared in the year following, was the celebrated novel of *Zeluco*, in which he has exhibited a character so atrocious, as rather to excite horror, than to afford amusement or instruction. The only prototype of such a personage in fictitious narrative (for surely none ever existed in real life) is the *Ferdinand Count Fathom* of Smollet, which Dr Moore, doubtless, had in his eye when he undertook this singular delineation. Both characters are utterly devoid of principle, and are equally profligate, perfidious, and selfish. Yet there are different shades in the characters of these fictitious wretches; Zeluco is a more daring and hardy, Fathom a more pliant and crafty villain. Fathom, too, in the commission of all his atrocities, is solely actuated by self interest, or the indulgence of the lowest sensual gratifications; whereas, Zeluco is excited to many of his blackest crimes by the strongest evil passions of our nature,—by hatred, envy, and revenge. Fathom has perfect command of temper, and never sacrifices his interest to caprice. Zeluco's temper, on the other hand, is ungovernable, and he disregards all consequences in the gratification of his rage and malice. The moral effect of all such pictures of depravity may well be doubted. Fathom, indeed, who is pointed out as a coward, a thief, and a sharper, is so utterly degraded, loathsome, and disgusting, that the contemplation of his character is only for the time a pollution of the imagination. But the high birth, personal attractions, gentlemanlike accomplishments, and courage of Zeluco, may, to an ill regulated mind, extenuate his enormities, and even spread the infection of his wickedness. It is true, that the history of Zeluco, who is the only son of a noble and wealthy family in Sicily, is intended to show the fatal consequences of uncontrolled passions, and excessive maternal indulgence: It is true, that, with every advantage of person, birth, and fortune, he is represented as utterly wretched from the depravity of his nature;—it is true, that an awful punishment is awarded to him in the catastrophe, and that he closes his life in paroxysms of penitence. But though the author's design may have been laudable, in the perusal, the moral scope is often as much lost sight of, as the recondite allegories of the *Orlando*, or *Jerusalem Delivered*. Such a picture, too, of the darkest tinges of villany, unmitigated by the intermixture of one good quality, harmonizes so little with the ideas or feelings of this country, that we revolt at its improbability; or, at least, the credence of reality, so essential to the success of every fictitious narrative, is hardly ever excited. Besides, the principal parts of the work are not such as afford scope for the display of the author's peculiar excellencies. The mind, however, is occasionally relieved by scenes of humour and pleasantry, by picturesque sketches, and interesting traits of character. The comic part, indeed, is infinitely superior to the tragic, and in it the author seldom fails. Of Transfer we have, perhaps, too much, but Buchanan is an admirable sketch. There is much light humour in the relation of the story of Rosolia, and the comic dialogue is invariably spirited and lively. Though now somewhat sunk in reputation, *Zeluco* was much admired on its first appearance, and was hailed as one of those productions which, by its knowledge of human nature, and reach of mind, redeemed the species of composition to which it belonged from the imputation of frivolity, and elevated fictitious narratives to a higher walk in the paths of literature.

In 1792 Dr Moore accompanied Lord Lauderdale to Paris, where he witnessed some of the prin-

cipal scenes of the Revolution, of which he published an interesting account on his return to England. The same journey supplied him with materials for his *View of the Causes and Progress of the French Revolution*, published in 1795.

The scenes which Dr Moore had hitherto exhibited, both in his travels and fictitious compositions, were copied from the manners of other countries. The novel of *Edward*, which he published in 1796, is entirely confined to the illustration of our domestic usages and national customs. Edward is a foundling, whom chance places under the protection of Mrs Barnet. Under her guidance his mind, which is intended as a contrast to that of Zeluco, gradually unfolds to every amiable and manly virtue. His character is exhibited in many trying situations, till at length, by a natural series of incidents, he is finally brought to the discovery of his reputable descent, and is united to a beautiful heiress, of whom he was enamoured, and of whom the person he discovers to be his mother is the guardian. The thread, however, by which the hero is connected with the other characters of the work is very slight, and the incidents are barely such as keep up its title to the character of a regular novel. It is not distinguished by originality of sentiment, by novelty of character, by deep involution of events, or by scenes of complicated distress or unexpected deliverance. But, without deeply interesting the feelings, the mind is kept, particularly through the conversation pieces, in an agreeable state of amusement; and it is wonderful that, in its perusal, we should experience so little lassitude, when there is so little excitation.

Mordaunt possesses something of the same sort of merit as *Edward*, but in an inferior degree. A series of letters from different persons, characteristically supported, was a species of novel which required great versatility of powers, and one in which the genius of Dr Moore qualified him peculiarly to excel. But it would appear that the brilliancy of his wit had been tarnished by too frequent exposure to the world, or that his natural vivacity had been somewhat diminished by the advance of age. He survived the publication of *Mordaunt* only two years, and died at London in 1802.

The reputation of Dr Moore with posterity will rest on his travels and novels. As long as they are read, he will be acknowledged as a writer endued with admirable good sense, a rich vein of original humour, an uncommon power of insight into human nature, and a capacity of describing its intricacies with force and discernment. (M.)

MORAYSHIRE, or MURRAYSHIRE, a county in Scotland. The province of Moray formerly included part of the shires of Inverness and Banff, and that of Nairn, besides the present county; but the name is now confined to this district, which is also known by the appellation of Elginshire. It is situated between 57° 12′ and 57° 43′ north latitude, and between 3° 2′ and 3° 58′ west longitude, extending about 40 miles from north-east to south-west, and in breadth from 8 to 14 miles in the interior, but upon the coast from 17 to 23 miles; and it contains, including its lakes, 480 square miles, or 307,200 English acres, of which only about a third is productive land. The county of Moray has the frith of that name on the north, Banffshire on the east, Inverness-shire on the south, and Nairnshire on the west. The river Spey, which, with a few exceptions, separates it from Banffshire, is commonly considered its eastern boundary. On the south, it is intersected by a small part of Inverness-shire, by which two parishes, Abernethy and Duthil, partly in[illegible] county, are detached from the body of it. It is divided into fifteen entire parishes, and contains part of nine parishes more, the rest of which are situated in the counties adjacent. The Presbyteries to which these parishes belong are, Aberlour, Abernethy, Elgin, and Forres, all under the jurisdiction of the Synod of Moray.

The natural divisions are the low grounds which stretch along the coast, varying in breadth, southward, from 5 to 12 miles, and the mountains which occupy the interior; yet the former is not without ridges of hills, of no great height, which generally rise in a line parallel to the shore; nor the latter without considerable tracts of low land, particularly on the branches of the Spey and Findhorn, and the other streams which flow from the south. The climate, soil, and productiveness of these two divisions are very different. The climate on the coast is supposed to be as good as that of any part of Scotland, both in respect to heat and dryness; while the prevailing soil is a sandy loam, in many parts affording plentiful crops, which ripen early, and are seldom injured by bad weather, in the harvest season. The wind blows from westerly points for almost three-fourths of the year. The strong gales are from the north-west, and the most frequent rains from this point and the north-north. Easterly winds, however, prevail in the spring months, to the great injury of vegetation. The annual fall of rain, on the north-east quarter, near Speymouth, is said to be little more than 25 inches; and the medium temperature of the year varies from 45° to 50°. In the mountain district, the winters are long and severe; more rain falls than on the coast; and the labours of the harvest are sometimes not brought to a close till the crops are covered with snow. Limestone, sandstone, and slate, with marl, abound in various parts. Iron was almost a century ago wrought in Strathspey by the York Buildings Company. The rivers are the Spey, the Lossie, and the Findhorn, which receive the waters of a great many mountain streams. The Spey, the most considerable, has a course of 30 miles before it enters Morayshire, at Aviemore, from which it flows in a deep channel, and with a considerable fall, till it empties itself, after describing a line of about 96 miles in all, into the sea at Speymouth Bay. It is not navigable, except near its mouth, and there only for small vessels; but it affords the means of bringing down to the sea the forests on its banks; and the rents of its salmon fisheries, some years ago, exceeded L.7000 *per annum*. The Lossie flows almost parallel to the Spey, about ten miles distant, and, after a course of 24 miles, during which it works a number of corn mills, falls into the sea at Lossiemouth, about six miles to the north of Elgin. The Findhorn, like the two former, flows from south to north, and enters the Frith of Moray at the village that bears its name, having

Morayshire. traversed Inverness-shire, where it has its source, Nairnshire, and this county, for a distance of 60 miles. There is also a valuable salmon fishery on this river. The principal lakes, beginning on the east, are Loughnaboe, which covers about 60 acres; Lough Spynie, which formerly spread over more than 2000 acres, but has been since laid almost dry by drainage; Inchstellie, Lochloy, and Loughnadurb, containing an island on which there are the remains of an ancient fortress, and where it is said turnips have been found growing naturally. Chalybeate springs are found in every quarter of the county, but none of them are in much repute.

Lakes.

Valuation and Rental

The valued rent of Morayshire, in Scots money, is L.65,603, 0s. 5d., and the real rent, in 1811, of the lands was L.62,312, 9s. 6d. Sterling, and of the houses L.2,753, 14s. 6d. In the same year, the number of proprietors was forty-one, five of whom held more than half the valuation and rental; and that of the freeholders thirty-six. Only about a fortieth part is held in feu, the whole, with this exception, and small portions belonging to the burghs, being freehold, but nearly a third is under entail. Many of the proprietors have elegant mansions, of which the most considerable, beginning on the eastern quarter, are Innes House, the Earl of Fife; Findrossie, Lesslie, Bart.; Gordonstown and Altyre, Cumming Gordon, Bart.; Duffus, Dunbar, Bart.; Darnway Castle, the Earl of Moray; Brodie House, Brodie; Grange, Peterkin; Burgie Castle, Dunbar Brodie; and Elchies House, Grant.

Seats.

Farms.

The size of farms on the coast does not often exceed 400 acres, and the greater number are below 150 acres. The larger farms are generally held on leases for nineteen years, as in other parts of Scotland, but many of the smaller tenants have no leases. This division of the county produces all the species of corn grown in Scotland, with turnips, potatoes, and clovers. In the higher district, barley and oats, with potatoes, are almost the only crops, with small portions of turnips and cultivated herbage, and in some places a little flax. The native cattle have been improved, by crossing them with the West Highland race; and the sheep, which were originally similar to those of Shetland, have, in many parts, given way to the Linton, or black-faced race, and a variety of other breeds from the south. On the small farms, especially in the mountain district, the horses are very diminutive, seldom more than nine or ten hands high; but, upon the larger farms on the coast, they are not inferior to those of other parts of Scotland. In the latter situation, two only are used at a plough, and oxen are seldom worked; whereas, the team in the high grounds consists of oxen and horses intermixed, sometimes to the number of six or eight. Morayshire

Manufactures.

Morayshire employs few of its people in manufactures for sale. A woollen factory has been established at Newmill, in the parish of St Andrews Lhanbryd, and in the same quarter another for the weaving of cottons. There are tanneries at Forres and Elgin; and, at the latter place, a tawing work of some consideration, which sends most of its produce to London. The exports are cattle, corn, and salmon, with a variety of smaller articles. The value of the salmon has been stated at about L.25,000, and that of all the other exports does not exceed L.30,000 yearly. A considerable quantity of timber is floated down the Spey, and shipped at Garmouth; but it is chiefly the produce of Strathspey, in Inverness-shire. The towns and villages are, Elgin, the county town, Forres, Garmouth, Urquhart, Lossiemouth, Bishopmill, Findhorn, Rothes, and Balnatom. The first two are burghs; Elgin is joined with Cullen, Banff, Inverary, and Kintore; and Forres with Inverness, Nairn, and Fortrose, in the election of members for the Scottish burghs. Both these places are of great antiquity. The population in 1800 and 1811 is exhibited in the following abstract. See Leslie's *General View of the Agriculture, &c. of the Counties of Nairn and Moray*. (A.)

Towns.

Population

1800.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Persons* chiefly employed in Agriculture.	*Persons* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Persons* not comprised in the two preceding classes.	Total of Persons.
5,992	6,354	134	11,763	14,942	8,131	4,410	14,164	26,705

1811.

HOUSES.			PERSONS.		OCCUPATIONS.			
Inhabited.	By how many *Families* occupied.	Uninhabited.	Males.	Females.	*Families* chiefly employed in Agriculture.	*Families* chiefly employed in Trade, Manufactures, or Handicraft.	All other *Families* not comprised in the two preceding classes.	Total of Persons.
6,268	6,854	197	12,401	15,707	2,635	1,886	2,333	28,108

MORTALITY, HUMAN, Law of.

The law of human mortality is that which determines the proportion of the number of persons who die in any assigned period of life, or interval of age, out of a given number of persons who enter upon the same interval; and, consequently, the proportion of them who survive that interval.

Tables showing how many out of a great number of children, as 10,000, or 100,000, born alive, die in each year of their age; and, consequently, how many complete each year; exhibit this law through the whole extent of life, and are called *Tables of Mortality*.

For information respecting the *data* from which such tables may be constructed, and the uses they may be applied to, the reader is referred to the articles Bills of Mortality and Annuities, in this *Supplement*.

There is already an article on this subject in the *Encyclopædia Britannica*, under the head Bills of Mortality; but the imperfections of that article, and the increasing importance of the subject, render it expedient that it should be resumed here, and treated entirely anew.

The present article is divided into three parts. In the *first*, we deliver the history of this branch of knowledge, with as much brevity as appears to be consistent with the chief object,—that of conveying correct and useful information.

In the *second part*, we demonstrate the whole theory by common arithmetic.

In the *third part*, a new table of mortality is given, constructed on the principles previously explained; some observations are made on the comparative merits of the different tables that have been published; which were purposely omitted in the historical part, when the tables they relate to were mentioned, to avoid discouraging such readers as might not be previously acquainted with the theory; and the faults are explained, which render most of those tables really of no use, since others, more correct, have been constructed.

Part I.—*History*.

The first table of mortality was constructed by Dr Halley, from the Mortuary Registers of Breslaw, for five years ending with 1691; and was inserted in his paper on the subject in the *Philosophical Transactions* for the year 1693, with many judicious observations on the useful purposes to which such tables may be applied.

No further information of this kind was communicated to the public, until William Kersseboom of the Hague published there three tracts on the subject (in 4to). The first, dated March 1, 1738, was entitled, *Eerste Verhandeling tot een Proeve om te weeten de probable menigte des volks in de provintie van Hollandt en Westvrieslandt*. The second, dated May 15, 1742, *Tweede Verhandeling bevestigende de Proeve om te weeten de probable meenigte des volks in de provintie van Hollandt en Westvrieslandt;* and the third, dated August 31, 1742, *Derde Verhandeling over de probable meenigte des volks in de provintie van Hollandt en Westvrieslandt.*

A good account of the first of these tracts has been given by Mr Eames, in the *Philosophical Transactions* for 1738; and rather a meagre one of the other two, by Mr Van Rixtel, in the same *Transactions* for 1743. It is therefore unnecessary to repeat here, any thing contained in those accounts; but as they give no satisfactory information concerning the construction of Mr Kersseboom's table of mortality (which he called a *Table of Vitality*), it will be proper to supply so material a defect in this place.

In his first tract, the author informs us that he constructed his table from registers of many thousand life annuitants, in Holland and West Friesland, which had been kept there from 125 to 130 years previous to the date of his publication; and showed how many of the nominees, or lives the annuities depended upon, were, at the time of their nomination, under one year old, between one and two, between two and three, and so on for all ages.

An exact account was also kept of the age at which each life of every class failed; whence it clearly appeared, what degree of mortality prevailed at every age above one year. But because very few children were nominated at or near their birth, he could not, from these registers, determine the mortality under one year of age. He therefore had recourse to mortuary registers and other observations; from exact accounts of which he found, with sufficient certainty (as he says), that out of 28,000 born alive, 5,500 died under one year. He also informs us, that, for this purpose, he made use of the observations of divers learned men in England and elsewhere, especially Major John Graunt's, upon the number of the people and the rate of mortality; and upon taking an average of the whole, he found it to differ but little from that just stated.

And this appears to be the only ground for the assertion made by most writers on this subject (probably copying from each other without having seen the original work), that Kersseboom's Table of Mortality was constructed from observations made upon annuitants in England as well as in Holland; also, that it was formed partly from observations made upon the inhabitants of some Dutch villages.

He first published his Table of Mortality in his second Tract, and in his third, he gave abstracts of the registers from which it was constructed;—these were contained in twenty-nine tables, twenty-two of which were for the two sexes separately; in the rest the sexes were not distinguished; and the ages at which the lives failed were generally given to the exactness of half a year.

The numbers of lives, whose current year of age at the time of their nomination was given precisely in these tables, were,

Males separately, -	1843
Females separately, -	1769
Males and Females, without distinction of sex,	1536
Total,	5148

And none of these nominees were above 12 years of age at the time of their nomination.

These, however, are only specimens of Mr Kersseboom's labours. He says there were so many lives in the registers, that he had not the courage to undertake extracting the necessary particulars for more than 50,000 of them; and in that, he was greatly assisted by his friend Thomas von Schaak.

Of all the lives, not more than 1 of 120 was past 55 years of age at the time of nomination.

Nicholas Struyck, in his *Aanhangsel op de Gissengen over den staat van het Menschelyk Geslagt, en de Uitreekening der Lyfrenten*, published at Amsterdam in 1740, at the end of the quarto volume, commencing with his *Inleiding tot de Algemeene Geographie*, gave, from registers kept at Amsterdam for about thirty-five years, two tables of observations made upon the duration of the lives of 794 male, and 876 female annuitants separately; and two tables of mortality he had constructed from them for the two sexes; both beginning with five years of age. These two, taken together, differ but little from that of Dr Halley; they represent the mortality to be considerably greater than Kersseboom's: having been constructed from so few observations, they are not entitled to much confidence, and appear to have been very little known or attended to.

This work of Struyck gave occasion to the publication, in the same year, of a small tract (in 4to) by Kersseboom, entitled, *Eenige Anmerkingen op de Gissengen over den staat van het Menschelyk Geslagt*, &c., wherein he accused Struyck of plagiarism, with but too much appearance of justice.

Neither Kersseboom nor Struyck gave any information as to the manner in which they formed their tables of mortality from the observations on which they were grounded. Mr Kersseboom informs us, that he submitted his table to Professor S'Gravesande, some years previous to its publication, and obtained his approbation of it for calculating the values of annuities on lives.

In the year 1742, Mr Thomas Simpson, in his *Doctrine of Annuities*, (see Art. ANNUITIES in this *Supplement*,) gave a table of mortality for London, being the same that had previously been constructed by Mr Smart, at twenty-five and all the greater ages, but corrected at all ages under twenty-five years, on account of the great number of strangers who settle in London under that age, which occasioned, till lately, a constant excess of the burials above the births. This correction Mr Simpson made by comparing together the numbers of christenings and burials; and observing, by means of Dr Halley's Table, the proportion between the mortality in London and Breslaw above twenty-five years of age.

In 1746, M. Deparcieux published (at Paris in 4to) his *Essai sur les Probabilités de la durée de la vie Humaine*, in which he gave six new and valuable tables of mortality; one of them constructed from the lists of the nominees in the French Tontines, principally those of the years 1689 and 1696, and the rest from the mortuary registers of different religious houses;—four of these showing the mortality that prevailed among the monks of different orders, and the fifth, that which obtained among the nuns in different convents of Paris. Those for the monks and nuns, with the exception of the tables of Struyck, mentioned above, were the first ever constructed for the two sexes separately.

The *Essay* of M. Deparcieux is written popularly, and with great perspicuity; he has given the most satisfactory accounts both of the *data* his tables were constructed from, and the manner of their construction.

In his thirteenth table, he included with the five tables of mortality of his own construction; that of Mr Smart for London, as corrected by Mr Simpson, Dr Halley's, and Mr Kersseboom's, together with the expectation of life *at*, or its average duration *after* each age, both according to his own and Mr Kersseboom's table for annuitants, and for every fifth year of age according to each of the other tables; the fractional parts of a year being always expressed in months, and not in decimals.

Dr Halley first, and Struyck after him, had given the *probable duration of life* after several ages, according to their respective tables, that is, the term at the expiration of which, the persons now living at any proposed age, will be reduced by death to one-half their present number.

But Deparcieux appears to have first given the *average duration of life* after any age, and showed how to calculate it correctly from tables of mortality. On account of the scarcity and value of M. Deparcieux's *Tables of Mortality*, Mr Milne has reprinted them, with the expectations of life just mentioned, in his *Treatise on Annuities*, with a short account of their construction; it is therefore unnecessary to pursue the subject further here.

M. de Buffon, at the end of the second volume of his *Histoire Naturelle*, published in 1749, inserted a table of mortality that had been constructed by M. Dupré de Saint Maur, from the registers of twelve country parishes in France, and three parishes of Paris; which M. de Buffon informs his readers that he inserted in his work the more willingly, since these were the only kind of documents, or combinations of them, from which the probabilities of life among mankind in general, could be determined with any certainty. Yet this was a very faulty table, and the numbers of annual deaths were so injudiciously distributed, according to the ages, that it often represented the mortality in one year of age to be three or four times as great, and in some cases, six times as great, as in the next year. Some remarks of M. Kersseboom on this table may be seen in the *Philosophical Transactions* for 1753. M. de Saint Cyran corrected some of its most obvious errors, and inserted both the original and his corrected copy in his *Calcul des Rentes Viageres*. (4to. Paris, 1779.)

Mr Simpson, in the *Supplement* to his *Doctrine of Annuities*, published in 1752, gave some further explanations of the corrections he had made in Mr Smart's table of mortality for London; and made some very judicious observations on the difficulties that attend the construction of tables of mortality from the mortuary registers only, of large towns.

In the *Nouveau Mém. de l'Acad. Roy. de Berlin* for the year 1760, there is a paper by the celebrated Euler, entitled *Recherches générales sur la mortalité, et la multiplication du genre humain*, wherein the subject is treated algebraically. He assumes that the population is not affected by migration, and that the annual births and deaths are always as the contemporaneous population; consequently, that the number of the people increases or decreases in geometrical progression. Then he gives several theorems exhibiting the relations that would obtain between the annual births and deaths, and the population, and determines the law of mortality upon these hypotheses, but does not show how it may be deduced from actual observations independent of hypotheses; neither does he undertake the construction of any table of mortality, but, by way of example, gives that of M. Kersseboom, with the changes of the numbers which become necessary, in consequence of his altering the radix from 1400 annual births to 1000.

Süssmilch took great pains in collecting the numbers of annual deaths in the different intervals of age, which he published in his *Göttliche Ordnung*; and four tables of mortality formed from these *data* are to be found in the same work: that in the 2d volume (§ 461), which has many imperfections was formed by himself; the three others, being the 21st, 22d, and 23d, at the end of the 3d volume, were constructed by his commentator Baumann, according to the more correct method of Lambert.

The first edition of Dr Price's *Observations on Reversionary Payments* appeared in 1771, containing his observations on the proper method of constructing tables of mortality from bills which show the numbers dying annually at all ages (see the article BILLS OF MORTALITY in this *Supplement*, p. 311), and three new tables of mortality constructed from the London, Norwich, and Northampton bills.

The second edition of the same work was published in 1772; and contained, in the *Supplement*, much interesting and valuable information which did not appear in the first; with five new tables, intended to exhibit the law of mortality that obtained,—1. In the district of Vaud, Switzerland. 2. In a country parish in Brandenburg. 3. In the parish of Holy Cross, near Shrewsbury. 4. At Vienna. 5. At Berlin. The first formed from bills of mortality given in the *Mémoire* of M. Muret; and the 2d, 4th, and 5th, from those given by Süssmilch in his *Göttliche Ordnung*; the 3d was from the parish register only, of Holy Cross. And we consider none of those tables to be now of any value, on account of the defects in the *data* they were constructed from.

At the end of the first volume of the work of J. H. Lambert, entitled, *Beiträge zum Gebrauche der Mathematik und deren Anwendung*, published at Berlin in 1765 (8vo), he gave a chapter *On the certainty of inferences deduced from observations and experiments*; and the example with which he concluded the illustration of his theory, was the deduction of the law of mortality in London from the bills of mortality there; by means of a curve, of which the absciss being proportional to the age, the corresponding ordinate was proportional to the number of survivors of the same age.

In the third volume of the same work, published in 1772, the ingenious author treated the subject at much greater length: x being the age, and y the corresponding ordinate to the curve of mortality for London, proportional to the number of survivors of that age out of a given number (10,000) born alive; he gave this equation to the curve, $y=10{,}000\left(\frac{96-x}{96}\right)^2 - 6176\left(e^{-\frac{x}{13\cdot682}} - e^{-\frac{x}{2\cdot43114}}\right)$, ($e$ being the number of which unit is the hyperbolic logarithm); which determined the numbers in the table of mortality very near the truth, until 96 years of age, beyond which it was not intended to be used.

M. Lambert also constructed a table by which he intended to exhibit the law of mortality that prevails among mankind in general, from the 23d and 24th tables in the second volume of Süssmilch's *Göttliche Ordnung*, which gave the numbers of deaths, in the different intervals of age, in seventeen country parishes in the mark of Brandenburg, and from the London bills for thirty years; supposing, with Süssmilch (*Göttl. Ordn.* T. I. § 34), that the country people are double the number of those residing in towns.

By an extract of a letter from M. Lambert to Gaeta and Fontana, given in their Italian translation of Demoivre's *Treatise on Life Annuities* (*Discorso Preliminare*, Parte III.), it appears, that all his attempts to find *à posteriori* an equation which should determine the relation between the age and the number of survivors in this last table, proved fruitless; the formulæ he arrived at having been either too long and intricate, or too incorrect. This is the less to be regretted, since there is no doubt that M. Lambert's table did not represent the true law of mortality, as he made no allowance for the effect of the increase of the people by procreation; and it is singular he did not see, that that law might be correctly determined from the numbers of the living, and the annual deaths at all ages in Sweden and Finland, given in Mr Wargentin's paper in the Stockholm *Transactions* for 1766; which paper he himself quotes.

Lambert appears to have first demonstrated clearly the principal properties of tables of mortality;* in doing which, he made use of the differential and integral calculus; but as he could not determine the

* The author thinks it right to observe here, that he did not see the above mentioned work of Lambert, until he procured it from the Continent in November 1819; and that he had published elementary alge-

Mortality. equation to the curve of mortality, that resource did not avail him much.

Florencourt treated this subject algebraically in the third chapter of his *Political Arithmetic* *, where he gave a perspicuous view of it, as it had been previously treated by Euler and Lambert; but added nothing himself that was original, except three new tables of mortality; one for males, another for females, and a third for both sexes without distinction; deriving his data in each case from the *Göttliche Ordnung* of Süssmilch. He also gave a new copy of the table of mortality M. Deparcieux had constructed from the registers of the nominees in the French tontines; assuming 10,000 for the radix, and inserting the numbers under three years of age, nearly according to M. Kersseboom's table; this, however, does not differ materially from the original table of Deparcieux.

The fourth edition of Dr Price's *Observations on Reversionary Payments* was published in 1783, and contained new tables of mortality for Warrington and Chester, also for all Sweden and Finland, and for Stockholm separately, in which the sexes were distinguished; those for the whole kingdom were constructed from enumerations of the living, and registers of the annual deaths, in each interval of age, during twenty one years; those for Stockholm during nine years. These tables for Sweden and Stockholm were the first ever constructed from the data that are requisite to determine the law of mortality among the bulk of the people, and were sufficiently accurate representations of that law, for the times and places in which the observations were mad .

In a paper of M. Henrik Nicander, inserted in the *Transactions of the Royal Academy of Sciences* at Stockholm, for the first quarter of the year 1801, he gave two tables of mortality for all Sweden and Finland, in which the sexes were distinguished, but they were not properly constructed; and the mean duration of life which he gave in them at each age, was very erroneous, especially in early life. In that paper he asserted, without offering any demonstration or proof, that, in what we have called the curve of mortality above, if an ordinate be drawn through the centre of gravity of the portion of the area cut off by the ordinate at any assigned age, on the side of the more advanced ages, the part of the base, or of the axe of the abscisses, intercepted between these two ordinates, will measure the mean duration of life after such assigned age. And the mean duration of life after each age, which he has given, was determined in this manner.

Mr Milne's *Treatise on Annuities and Assurances* was published in 1815; and, in the third chapter of that work, the construction and properties of tables of mortality are fully treated of.

In the second volume of the same work, three new tables of mortality are given; one constructed from very accurate observations made at Carlisle, by Dr Heysham, who preserved the bills of mortality of the two parishes, which include that city and its environs, and supplied their deficiencies with great care, together with correct accounts of two enumerations of the inhabitants, in which their ages were taken. Except the Swedish registers and enumerations, this is the only instance in which the *data* requisite for the construction of an accurate table of mortality for the bulk of the population, have been obtained; and a table showing the diseases by which the deaths at all ages were occasioned, is also given. Mortality.

The fourth and fifth tables in Mr Milne's work, exhibit the law of mortality which prevailed in all Sweden and Finland, both with and without distinction of the sexes, deduced from the registers kept and the enumerations made there, during the twenty years ended with 1795; which term was subsequent to that wherein the observations were made, from which Dr Price's tables were constructed.

The seventh table in the same work exhibits the law of mortality at Montpellier for males and females separately, and was constructed from the bills of [illegible]tality of that place for twenty-one years, ending [illegible] 1792.

PART II.—*On the Construction and Properties of Tables of Mortality.*

1. Suppose 10,000 children to have been all born alive at the same instant of time, more than 100 years since; and that the numbers of them who completed and wh[illegible]d in each year of age were correctly entered in the following table:

Age.	Number who completed the Year.	Number who died in the year next Year.
0	10,[illegible]	[illegible],858
1	8,[illegible]	53
2	[illegible]059	250
3	7,403	177
4	[illegible]26	130
5	[illegible],096	112
⋮	⋮	⋮
90	49	15
91	34	11
92	23	9
93	14	5
94	9	4
95	5	2
96	3	1
97	2	1
98	1	1

braical demonstrations of the properties of tables of mortality, as well as of the best methods of constructing them, in March 1815.

* *Abhandlungen aus der Juristischen und Politischen Rechenkunst*, von Carl Chassot de Florencourt, Altenburg, 1781, 4to.

which, then, would evidently be a table of mortality; and this mode of constructing one, were it practicable, would be the simplest possible.

2. But of 10,000 children taken indiscriminately at birth, it is manifest that the number who complete or survive any year of age, will be just the same, whether they be all born at the same time or not; and, therefore, this table might as well have been constructed by noting the times of the births of 10,000 children taken indiscriminately, and registering the time or the age at which each died; for then, after the whole were extinct, it would only be necessary to collect the sum of those who died in each year of their age, and insert it in the third column of the above table (1) against the proper age. The numbers in the second column would then be obtained by beginning with the 10,000 births, and merely subtracting the number in the third from the number in the second column, and placing the remainder in the next line below, in that second column, throughout the table.

3. It is evident that the number against any age in the second column of such a table is equal to the sum of those in the third column against that, and all the greater ages; that is to say, that *the number who complete every year of age is equal to the sum of those who die at all the greater ages.*

4. Now let us suppose the population of a place to have remained invariable for one or two hundred years past, during which period 10,000 children have been born alive, at 10,000 equal intervals of time in each year. Also that there having been no migrations, and the law of mortality having been always the same, both the number of the living and that of the annual deaths in each year of age, have remained constant, the whole amount of the annual deaths at all ages, as well as the number of annual births, having been 10,000.

5. Then, if the law of mortality exhibited in the above table (1) be that which obtains in the place last mentioned, that table will represent the stream of life which flows through it, and fills the vacancies left by those who advance in age, or are carried off by death, their successors incessantly following and being followed in the same course.

6. Thus:—10,000 children being born annually at so many equal intervals of time, 7096 will annually complete their fifth year, also at equal intervals; and of these, 112 will die annually in the sixth year of their age.

7. And it is manifest, that, *the number who annually complete any year of their age in such a place, is equal to the sum of the annual deaths at all the greater ages.*

8. Let us next suppose, that the constant number of deaths which happen annually in any one year of age, take place at equal intervals of age in that year. For instance, that the four deaths which happen annually, in the 95th year of age, always take place at the ages of

Years.		Months.
94	-	3
94	-	6
94	-	9

and 95 years; or rather, that the last individual dies at the moment before completing the 95th year.

9. Then the number constantly living in any year of age may be determined as follows:

Let us take, for example, the 94th year, which 14 persons annually enter upon, and 5 die in.

Now, if no deaths happened in that year, it is obvious that the 14 persons who annually enter upon it at so many equal intervals (4 and 6), would be all constantly living at 14 equal intervals of age in that year; and if that year of age were divided into five equal intervals, there would be constantly living in each interval $\frac{14}{5}$ persons; or, in a place similarly circumstanced, but five times more populous, 14 persons.

But when five deaths take place at so many equal intervals in the 94th year of age; (the fifth part of a year being 73 days,) the case is altered:—Thus,

Lives.	Complete the Age of		Number of the Living during these last 73 Days.
	Year	Days	
14	93	73	$\frac{14}{5}$
13	93	146	$\frac{13}{5}$
12	93	219	$\frac{12}{5}$
11	93	292	$\frac{11}{5}$
10	94	—	$\frac{10}{5}$

Hence, the oldest life that fails in the 94th year, must be considered to expire the moment before completing that year, as only 9 *survive* 94.

But the numerators of these fractions being in arithmetical progression, their sum is equal to half the sum of the first and last terms multiplied by the number of terms; or $\frac{14+10}{2} \times 5$: which sum being divided by the common denominator, 5; we have the number of the living in the 94th year of age $= \frac{14+10}{2}$; an arithmetical mean proportional between the numbers who enter upon the first and last of the intervals which that year of age was divided into.

10. Now the number, 9, who survive their 94th year, is less only by unit than the number 10, who enter upon the last of the intervals that year was divided into; so that if, instead of $\frac{14+10}{2}$, we take $\frac{14+9}{2}$, or an arithmetical mean proportional between the numbers who annually enter upon, and annually survive their 94th year, for the number constantly living in that year, it will only be less by half a life than what has just been demonstrated to be the true number, according to the hypotheses; and the difference would still have been but half a life, although the radix of the table had been 10,000,000 instead of 10,000; the number of the living would, in that case, according to these two methods, have been 1200 and 1199½. And the number of the living

in any one year of age, even according to the above table, is generally several thousands; so that this difference, which remains always the same, is quite immaterial.

Besides, it is obvious that the above hypotheses can never coincide exactly with the facts. And the above reasoning is evidently applicable to any other year of age.

11. We are therefore authorized to conclude, that, in a place circumstanced as above stated, *the number of the living in any year of their age, is an arithmetical mean proportional between the numbers who annually enter upon, and who annually complete that year.*

12. Thus it appears that

The number of the living in their	Is half the sum of
94th year,	14 and 9,
95th ——	9 and 5,
96th ——	5 and 3,
97th ——	3 and 2,
98th ——	2 and 1,
99th ——	1 and 0.

But it is to be observed, that the same numbers occur in the first of these two series as in the second, except the first term of the first, and the last of the second, which are 14 and 0 respectively. Therefore the sum of the second of these two series falls short of the sum of the first, by 14, the number who annually complete their 93d year; so that the series of half sums falls short of the sum of the first series by 7, the half of 14. And this reasoning will apply equally to any other age than that of 93 years.

13. Whence it follows, that, in a place circumstanced as we have supposed, *the number of persons constantly living at any assigned age and upwards, is less than the sum of those who annually complete that and all the greater ages, by half the number who annually complete that year of their age.*

14. From the supposition that the number of persons who die annually in any one and the same year of age, expire at so many equal intervals of age in that year (8), it follows, that, for each of these lives which fails before the middle of that year of age, there will be another which will fail just so much after it; and, consequently, that the average quantity of existence during any year of age, for the lives that fail in it, is just half a year.

15. But in taking, for any one year of age, the sum of the numbers in the second column of the table (1) at all the greater ages, each life is counted once for every complete year it survives, after the age first mentioned; and if, to the sum of these, we add half the number in the same second column against that first mentioned age, this half number being the sum of the fractional parts of a year, by which the whole of these lives survive the last year of age they complete (14); the sum total thus obtained, will evidently be the whole duration of life after the age first mentioned, enjoyed by all the lives that survive that age in any one year.

16. Therefore, if this last sum total be divided by the number who annually survive that first mentioned age, the quotient will be *the mean duration of life after that age;* which is also called *the expectation of life at the same age,* being the portion of future existence which an individual at that age may reasonably expect to enjoy.

17. But, by No. 13 it appears, that the last mentioned sum total is also the number constantly living in the place, at and above the age first mentioned (15).

18. Whence, and from No. 16, it follows, that if the number of the living in the place at any age and upwards, be divided by the number who annually complete that age, the quotient will be the mean duration of life after the same age.

19. And, consequently, if the number constantly living at all ages, be divided by the number of annual births, the quotient will be the mean duration of life from birth, or the expectation of life of a child just born.

20. Hence also it appears, that the number of years in the expectation of life at any age, is the same as the number of living persons at that age and upwards, out of which one dies annually.

21. Thus, for example, the expectation of life at 40 years of age being 25.495 years, the proportion of the living in the place aged 40 years and upwards who die annually, is one of 25.495, or, which is the same, 1000 out of 25,495.

22. The numbers represented by a table of mortality to die in any intervals of age, are called *the decrements of life* in those intervals.

23. And the interval between any age and the utmost extent of life, according to any table of mortality, is called *the complement of life* at that age, according to the same table.

24. If the decrements of life be supposed to be equal and uniform through its whole extent, and the interval between birth and the utmost extremity of life be divided into as many equal parts as there are annual births; then, one of the individuals born, will die at the expiration of each of these equal intervals of age; and the numbers who survive the several intervals, from birth to the extremity of life, will form an arithmetical progression.

25. Whence it will be found (11), that the number of the living at any assigned age and upwards, will be equal to the number who annually complete that age, multiplied by half the number of years in the complement of life at the same age.

26. And if this last product be divided by the number who annually complete that age, the quotient, that is, *half the complement of life, will be the expectation of life at that age* (18).

27. The mean numbers of annual deaths at all ages, or, which in this case is the same, the number of deaths in each year of age, that take place during any one year in a place circumstanced as we have supposed, being given, a table may be constructed as follows, which will answer all the most interesting questions that can be put respecting the population and mortality of the place.

28. Let there be five columns; in the first of which insert the ages 0, 1, 2, 3, 4...................... 96, 97, 98, 99, and against every age, insert in the fifth column, the given number that died in the year

between that and the next greater age; then begin at the greatest age, and proceed towards the least, as follows:

1*st*, To the number against any age in the fourth column, add that against the next less age in the fifth, and insert the sum against that next less age in the fourth (7).

2*d*, To the sum of the numbers in the third and fourth columns against any age, add half the number in the fifth column against the next less age, and insert this last sum against that next less age in the third column (11).

3*d*, Divide the number against any age in the third column, by the number against the same age in the fourth, the quotient will be the expectation of life at that age, to be inserted in the second column (16).

1.	2.	3.	4.	5.
Age.	Expectation of Life at that Age.	Number of the Living at that Age, and upwards.	Number who annually complete that Year of their Age.	Number who die annually in their next Year.
0	39.385	393,848	10,000	1888
1	....	....	....	......
2	....	....	....	......
3	....	....	....	......
⋮	⋮	⋮	⋮	⋮
90	2.357	115.5	49	15
91	2.176	74.0	34	11
92	1.978	45.5	23	9
93	1.928	27.0	14	5
94	1.722	15.5	9	4
95	1.700	8.5	5	2
96	1.500	4.5	3	1
97	1.000	2.0	2	1
98	0.500	0.5	1	1
99	0	0	0	0

A complete table of this kind for the two sexes separately, formed from observations made in all Sweden and Finland, during twenty years ending with 1795, will be found in Mr Milne's *Treatise on Annuities and Assurances*, being the fourth in that work.

29. Hitherto we have supposed the state of the population to continue invariable for 100 years at the least, on account of the facility with which tables of mortality might be formed from accurate mortuary registers in such circumstances.

But whether the population be stationary or increasing or decreasing, and from whatever causes these changes proceed, provided that they be produced gradually, and not by sudden starts during the time of the observations, the law of mortality may be determined from actual enumerations of the people, and the bills of mortality, thus:

30. Let the number of persons in each year of their age, that are resident in a place at any one time, be taken, and let an accurate register be kept of the number that die annually in each year of their age, during a term of eight or ten years at the least, whereof the first half may precede, and the second follow the time of the enumeration.

Then, if the number of the inhabitants of every age either increase or decrease uniformly during that term, the mean number of annual deaths in each year of age thus registered, will be the same as if the population of the place had continued throughout that term what it was when the enumeration was made.

31. But if, to the number of the living in any year of age, we add half the number who annually die in the same year, the sum will be the number who annually enter upon that year of their age (11).

And thus, from the enumerations and registers above mentioned, may be derived the ratio of the number who annually enter upon any year of their age, to the number who annually die in it.

32. But all the observations which have been made with sufficient minuteness, on the mortality during the first year from birth, concur in showing, that many more deaths take place in the first few weeks from birth, than in equal periods of time during the remainder of the first year; and that the nearer to birth, the greater is the mortality among infants. So that the number of the living in successive equal intervals in the first year of age, cannot be correctly assumed to be in arithmetical progression.

33. On this account it is desirable that the annual numbers, both of the children born alive, and the deaths under one year of age, should be correctly registered, as in Sweden.

34. Then, as the number annually born alive, is to the number of annual deaths under one year of age, according to the registers, so is the radix of the table of mortality, to the number dying under one year of age according to that table, which, being subtracted from the radix, the remainder is the number who complete their first and enter on their second year. Whence the numbers, both of survivors and annual deaths, at all the greater ages, may be determined in the order of their succession by No. 31.

35. If, instead of the number of the living in each year of age being taken only once, according to No. 30, that operation be performed several times during the term for which the mean number of annual deaths in each year of age is given;—then, the mean number of the living in each year of age throughout that term, must be deduced from the given numbers; and, being substituted for the number at the middle of the term according to No. 30, the law of mortality may be determined with more certainty, than when the people are only numbered once.

36. Both in enumerations of the people, and in bills of mortality, the numbers are, however, almost always given only for intervals of age of several years each. For the manner of interpolating the numbers in each particular year of age, the reader is referred to Mr Milne's *Treatise on Annuities and Assurances*, Arts. 180 and 181.

PART III.—*On the Law of Mortality as deduced by the preceding methods from actual observations; and on the comparative merits of the different Tables of Mortality that have been published.*

37. When the uniformity of anatomical structure in different individuals of the human species is considered, and the great power possessed by the human body, of so adapting itself to the circumstances it is placed in, as to avoid injury from changes in those circumstances, it will appear natural to expect, *a priori*, that, where the circumstances of the people are not greatly different, the law of mortality will be nearly the same. And, from a comparison of the best tables of mortality yet constructed, we are induced to believe that this expectation will be realized, whenever a sufficient number of good observations shall have been made, under circumstances sufficiently varied.

38. Hitherto, no observations have been made from which the law of mortality may be correctly determined, except

1. Those of Kersseboom, in Holland.
2. Deparcieux's, in France.
3. The Swedish.
4. Dr Heysham's, at Carlisle.

Those of Kersseboom and Deparcieux were made only on select classes of the people; the Swedish are incomparably the most numerous and extensive; but Dr Heysham's will, we believe, be found to be best authenticated, and most correct.

39. The climate of Sweden is so unfavourable to the products of agriculture, and the number of the people is so great in proportion to the quantity of food produced, that unfavourable seasons there, are generally followed by distressing dearths, and the destructive epidemical diseases constantly attendant upon famine, which raise the mortality, when they occur, much above what it would otherwise be; and both in that way, and by weakening the constitutions of those who survive them, they materially increase the average mortality deduced from observations made during any considerable number of years. Of this the reader will find ample proofs drawn from authentic sources, in the 10th, 12th, and 13th chapters of Mr Milne's *Treatise on Annuities*.

40. For these reasons, the mortality in Sweden deduced from many years' observations, will be found to be higher than in the more temperate and fruitful parts of Europe. And we shall probably make the nearest approach to the general law of human mortality in the temperate climates, that can be made from the Swedish observations, by selecting a period in which no remarkable epidemics prevailed. Such a period was that of five years commencing with 1801 and ending with 1805; during which, according to a statement of M. Nicander, in the *Transactions of the Royal Academy of Sciences at Stockholm* for the year 1809, the population and mortality were as stated in Table I. at the end of this article.

41. From these *data*, the second table, at the end of this article, has been formed. The numbers in the columns for males and females separately, having been determined according to Nos. 36 and 31—35; assuming that, of 20,000 children born alive, 10,219 are males, and 9,781 females, in the ratio of 275,599 to 263,812.

The numbers against each age in the columns for the whole population without distinction of sex, are arithmetical mean proportionals between the corresponding numbers in the columns for males and females separately, against the same age.

42. From the table last-mentioned, Table III. has been deduced by No. 16, exhibiting the expectation of life *at* every fifth year of age; or its mean duration *after* that age.

43. Vaccination commenced throughout Sweden and Finland in 1804, during which year, the number vaccinated was 38,255; and, in the year following, 42,839.

The number of deaths by small-pox there, during the year

1801,	was	6,458
1802,	—	2,679
1803,	—	8,610
1804,	—	3,764
1805,	—	1,887
	Sum,	23,398
Annual average number,		4,680

While the annual average of the ten years ending with 1803, was 6962. (*Vet. Ac. Handl.* 1809, and Milne *On Annuities*, Art. 698.)

44. Therefore if we assume that, had vaccination not been practised in the years 1804 and 1805, the annual average number of deaths during the five years ending with that last-mentioned, would have been greater by 2,282 than it actually was, and that these 2,282 additional deaths would have all taken place under five years of age, both assumptions will be near the truth; and it will follow, that the annual mortality under five years of age, which actually was but one of 13.534, would have been one of 12.629, had vaccination not been introduced. Its introduction cannot have affected the three first tables above five years of age; and under that age, not quite so much as has just been stated.

45. Of all ages, and both sexes, there actually died annually, during these five years, one of 40.901; had vaccination not been practised at all, the annual average mortality would not have been so great as one of 39.759.

46. Table IV. exhibits the mean duration of life after every fifth year of age, according to twelve different tables of mortality; the first six, A, B, C, D, E, F, having been constructed from the requisite *data* (30 and 38), the last six, M, N, O, P, Q, R, from mortuary registers only.

47. Of the first six tables, Kersseboom's (C), although constructed from great numbers of accurate observations, is entitled to less confidence than the rest, as he did not explain how he constructed it. If we knew it had been properly formed, it would afford ground to conclude, that until about 45 or 50 years of age, Holland was less favourable to the duration of human life than the rest of Europe, but not afterwards.

48. Deparcieux's Table (B), constructed from

great numbers of accurate observations on the nominees in the French Tontines, resident principally in Paris and its environs, represents the duration of life too small after 60 or 65 years of age. (See Mr Milne's *Treatise on Annuities*, Articles 867 and 868.)

49. Column D has been taken from the 45th Table in Dr Price's *Observations*, E from the 5th in Mr Milne's *Annuities*, and F from the 3d Table in this article. All these tables represent the duration of life in Sweden and Finland, after 45 or 50 years of age, to be less than according to the others; and it might reasonably be expected, *a priori*, that the excessive cold in Sweden would be unfavourable to the prolongation of life in old age.

50. Of the less correct columns, M has been deduced from the 7th Table in Mr Milne's *Annuities*, and N from the 42d in Dr Price's *Observations*; but, as the Montpellier and Chester Tables, just referred to, give the expectations of life only for males and females separately, the numbers in columns M and N against each age, are arithmetical mean proportionals between the expectations for males and females against the same ages in those tables; which, though not quite correct, is fully sufficient for our present purpose.

51. Column O has been derived from Lambert's Table for mankind in general, already mentioned in the historical part of this article, in which he gives a column headed *mean age*; thus, against the age of 20 in that column, stands 54.3; by which he means that persons who survive 20 years of age, do, on an average, attain the age of 54.3 years; so that their expectation of life at 20, will be 34.3. But his numbers in that column are all too great by ½, or 0,5, as he has himself demonstrated; the last, therefore, should be 33,8; and

Against the Age of	For his Number.	We insert in Column O.
0	29.5	29.00
5	47.7	42.20
10	51.4	40.90
15	53.1	37.60
	and so on.	

52. The reason assigned by Lambert for voluntarily admitting this error at each age, as well as the corresponding one in the number of the living at and above the same age, into his table, was, that he did not consider the *data* in his possession enabled him to determine the duration of life within half a year of the truth.

53. In both these errors M. Lambert has been followed by J. C. Baumann, in constructing the 21st, 22d, and 23d tables inserted at the end of the third volume of Süssmilch's *Göttl. Ordn.* which were intended to represent respectively, the law of mortality among the country people in the churmark of Brandenburg, among the whole population of the churmark, and among the inhabitants of London.

54. Column P has been taken from the 4th table in the above mentioned work of Florencourt, which was also intended to represent the law of mortality among mankind in general, and was constructed partly from the registers of the same seventeen country parishes as that of Lambert, but instead of combining them with the London bills only, Florencourt also used those of Paris, Vienna, Berlin, and Brunswick; all given in Süssmilch's second volume; assuming also that the inhabitants of the country are to those of large towns as two to one. He determined the expectations of life according to the correct method, but not with much care or accuracy; for there are several numerical errors in that table.

55. The numbers in column Q were calculated by Deparcieux from Dr Halley's table; and those in column R have been extracted from the 18th table in Dr Price's *Observations*.

56. Upon comparing the numbers in the first six of these columns, which are more correct, with those in the last six, which are less so; it will be found, that at the early periods of life, its future mean duration according to the tables formed from mortuary registers alone, is less than according to those formed from the requisite *data*; also that the difference is greater the younger the lives are, and diminishes while the age increases, so as at 60 or 65 years of age to be little or nothing, and to continue small, and variable both in kind and magnitude, through the rest of life.

57. This appears to have arisen from the number of the people having varied but little during the first 35 or 40 years of the century that ended at or about the middle of the term in which the observations were made; and having increased considerably by procreation, during the remainder of that century; such increase having been slow at first, but gradually accelerated afterwards.

58. Table V. is calculated to illustrate this part of the subject. The columns A and B represent the law of mortality among the whole population of Sweden and Finland without distinction of sex, having been merely copied from Table II.

Column C shows the proportion of 10,000 annual deaths in Sweden and Finland that took place in each year of age, on an average of five years ending with 1805. And the number in column D against any age, being the sum of those in column C against that and all the greater ages, would be the number who annually attain to that age, if the number of the people of every age had remained stationary from the year 1700 till 1806 (7).

59. The table of mortality formed by the columns C and D therefore, is that which Dupré de Saint Maur, Süssmilch, Lambert, Baumann, and Florencourt, for want of the mortuary registers of a whole country, endeavoured to form by combining the registers of different town and country parishes.

60. But it has been ascertained by repeated enumerations of the people in Sweden and Finland, that the hypothesis of their number having remained stationary for the last 100 years or more, is far from the truth. And by comparing columns A and B with C and D, it will be seen in what manner, and to what degree, the falsity of the hypothesis in this case, has vitiated the table derived from it.

61. To facilitate this comparison, columns E and F have been added. Taking the age of five years

Mortality. for an example; the numbers against that age in columns C and D show, that, according to the hypothesis, out of 5988 children who annually enter upon their 6th year, 144 die in it; while it appears by columns A and B, that out of 7096 children who enter upon that year of their age, only 112 die in it: and 112 : 7096 :: 144 : 9123, so that 9123, inserted against the age of five years in column E, is the number of childern annually entering upon their 6th year, out of whom 144 *really* die in the same year of their age; and the mortality as represented by the hypothetical table in this case, is to the true mortality, as 9123 to 5988, or as 3 to 2 nearly.

Then the number in column F against any age, is always the excess of that in E above that in column D against the same age.

62. Columns B and C both containing 10,000 deaths, it will be seen that in column C, they are greatly accumulated at the early ages, in comparison with those in column B; and that in old age, the deaths in column C are much less numerous than in B; which are necessary consequences of the people increasing by procreation; the numbers of the people in a progressive population, in comparison with a stationary one, being greater in early life, and less in old age: And, while the law of mortality remains the same, the numbers of deaths at the different ages, must necessarily be distributed in a similar manner.

63. Neglecting those who survived 100 years of age, as inconsiderable in comparison with the rest. If the number of annual births in Sweden and Finland had remained stationary from the year 1700 till 1735, all that were born in that interval, would, during the term of our observations, have been between 65 and 100 years of age; and, if the law of mortality had remained invariable, the numbers in columns C and D, in Table V., would, during that period of life, have been exactly the same as those in columns B and A respectively against the same age; and the number in column F against each of those ages would have vanished, or been reduced to nothing.

64. But if the population and annual births had decreased a little from 1700 till 1735; then, the true and hypothetical laws of mortality, after 65 years of age in this table, would have differed the opposite way to what they do in early life; and the numbers in column F, after 65, would all have been negative.

65. Lastly, If the number of annual births from 1700 till 1735 varied but little, having sometimes increased and sometimes decreased, the differences of the tables, and the numbers in column F, after 65 years of age, would be such as we find them.

66. Table VI., which needs no further explanation than is placed at the head of it, will also illustrate the difference between tables of mortality formed from the requisite *data*, and those constructed from mortuary registers only.

It is better fitted for this purpose than Table IV., with which, however, it will be found to correspond very well. But the 4th Table has other uses which this has not.

67. From what has already been advanced, it would appear probable, that the number of annual births in Sweden and Finland had been nearly stationary, and rather decreasing than increasing, upon an average, from about 1700 till 1735. Mortality.

The numbers both of the annual births and deaths, from the year 1749 till 1803, will be found in Mr Milne's *Treatise on Annuities*, Art. 698: these kind of returns to Government were not made before 1749, neither have we any satisfactory account of the population before that period.

68. But the statements in our 7th table corroborate the inferences just drawn from the 5th and 6th, as they show that during the 43 years ended with 1800, the total population increased, while the proportion above 90 years of age diminished through the whole term, and increased very little during the next ten years.

The numbers in that table include both sexes, and the long continued diminution of them past 90, cannot be explained by supposing the males to have fallen in battle; for the females were reduced in the same proportion, their number throughout, having been to that of the males above 90 years of age, as nine to five nearly.

From the 7th table, therefore, it appears probable, that the annual births in the years 1698, 1705, 1710, and 1715, were respectively proportional to the numbers - - 907, 637, 837, and 786.

The last number, 786, has been calculated upon the supposition that the proportion of the population in Sweden and Finland to those in Sweden alone, was the same in 1810 as in 1805.

69. It should also be observed here, that the disastrous career of Charles the Twelfth commenced with the eighteenth century, and terminated in 1718, when the country was in such a state of exhaustion as it could not have recovered from for many years; whence there appears reason to believe, that the annual births during the succeeding fifteen or twenty years, did not increase fast.

Cantzlaer informs us, that between the 10th August 1710, and the month of February 1711, near 30,000 persons were carried off by the plague in Stockholm alone. (*Mem. du Royaume de Suede*, T. I. p. 29.)

70. It will be seen that the numbers in col. F of Table V., in proceeding back from four years of age to birth, continually decrease, contrary to what generally obtains; and as we ascribed the general increase of these numbers, when taken in the retrograde order of the ages, to the annually increasing number of births, so will this anomalous appearance be found to arise partly from the average number of annual births having actually *decreased* for a few years; for

During the Five Years ending with	The Annual Average Number of Births was
1800	107,690
1801	106,392
1802	105,504
1803	104,644
1804	105,430
1805	107,882

But it appears to have arisen principally from the practice of vaccination during the years 1804 and 1805, by which the mortality among children, or the numbers in col. C, in a few of the first years from birth, were reduced below what they otherwise would have been (44), while those in col. D remained nearly the same (58); consequently, the numbers in col. E were reduced in nearly the same ratio as those in C (61), and the reduction in col. F was in each case nearly the same as in E (61).

71. The numbers relating to Sweden and Finland in the 7th Table, have been derived from the Stockholm *Transactions* for the years 1766, 1801, 1809, and 1813.

Those relating to Spain and the Spanish possessions in Europe and Africa, including the Canary Islands, from the *Censo de la Poblacion de Espana en el ano de* 1797, mentioned in the Article Bills of Mortality in this *Supplement*. These last have been included in this Table, to show the difference in the proportion of aged persons in Spain and Sweden, and still more between the Canary Islands and both.

72. If the population of Spain had remained invariable from 1697 to 1797, the law of mortality there, might have been easily derived from the statements above mentioned of the enumeration in 1797; but in the actual state of things, that cannot be determined without comparing these with exact accounts of the numbers that died annually in each interval of age. And the author avails himself of this opportunity to state, that, since the Article Bills of Mortality was printed, he has obtained satisfactory information that no such returns from the parish registers throughout Spain, as are there mentioned, ever were published, nor is it probable they were ever made.

73. When what we have advanced respecting the 5th and 6th Tables is clearly understood, it will not be difficult to account for the greater part of the difference between the more and less correct columns in Table IV.

Most of the observations which the German tables were constructed from, were made between the years 1720 and 1750; and those who died then between 60 and 100 years of age, must have been born between 1620 and 1690; in which period nearly the whole of the thirty years' war, ended in 1648, was included, during which, and for several years after, it is probable that the annual births increased little or nothing, if they did not decrease.

74. Among the less correct columns of Table IV., those for Montpellier and Chester agree much better than the rest with the more correct ones, which has probably arisen in each case, partly from the mortality in these two places having really been less throughout life than in most large towns; and partly from the annual births in them, having increased less than in the other places, during the fifty or sixty years preceding the period in which the observations the tables were constructed from were made.

75. The Northampton Table was constructed by Dr Price, from the bills of mortality (from the year 1735 to 1780) of the single parish of All Saints, containing a little more than half the inhabitants of the town; and as the deaths exceeded the births in number, the Doctor applied a correction to the table under twenty years of age, which, if it had answered the intended purpose under that age, as we are satisfied it did not, could have no effect on any of the numbers above the same age; and almost all the useful applications of such tables, are to ages above twenty.

76. The table so formed could only be correct, provided that the numbers, both of the living and the annual deaths at every age above twenty years, had continued invariable during the 146 years that intervened between 1634 and 1780; provided also, that no migration from or to the town took place, except at twenty years of age, and that the annual increase the population received by migration at that age, was just equal to the excess of the annual deaths above the annual births.

77. But we consider it to be much more probable, that during these 146 years, Northampton partook of the prosperity and adversity that prevailed in the rest of the kingdom; and, consequently, that its population was generally progressive, though sometimes stationary, and sometimes retrograde.

78. We have not room here to support this opinion by numerical statements and calculations, but from the population abstracts, and an enumeration of the inhabitants of Northampton, given in Dr Price's *Observations on Reversionary Payments*, Vol. II. p. 94, it will be found, that both the annual births, and annual settlers in that town, have been increasing ever since about the year 1715 or 1720; also, that although the burials exceeded the baptisms till the year 1802, the supply by migration was much greater than that excess; and, consequently, that the numbers of the living have been accumulated more at the early ages, and less at the advanced ones, than they would have been had the population remained stationary.

79. Thus it appears, that the faults in the Northampton Table are of the same kind as those of the others constructed from mortuary registers only. And the civil war in the time of Charles the First, with the unsettled state of the kingdom for some years before and after it, would probably have prevented, or greatly retarded, the increase of the annual births, during the time in which those persons were born, who died past sixty years of age between the years 1734 and 1781, and may account for the table after that age, being near the truth; while the comparatively rapid increase of the people during the sixty years ending with 1780, appears to explain the great excess of mortality in that table at the early periods of life.

80. As it is only from the Carlisle and Northampton Tables of Mortality, that tables of the values of annuities on single and joint lives have been calculated, sufficiently copious to admit of the values of interests dependent upon the continuance or the failure of human life being accurately derived from them; we will here give, at one view, a comparison between the mortality represented by each of these tables to take place at the different periods of life, with that which has been observed to obtain among the members of the Equitable Assurance Society.

81. From an address delivered at a general court of that society by Mr Morgan the Actuary, on the 24th of April 1800, it appears, that, according to the result of an annual experience of thirty years, the decrements of life (22) among the members of the society, were to those in the Northampton Table,

Between the ages of	10 and 20	as 1 to 2
	20 — 30	— 1 — 2
	30 — 40	— 3 — 5
	40 — 50	— 3 — 5
	50 — 60	— 5 — 7
	60 — 80	— 4 — 5

The same information may also be found in two notes in Dr Price's *Observations on Reversionary Payments*, Vol. I. p. 183, and Vol. II. p. 443, by which it also appears, that the number of lives this experience was derived from, exceeded 83,000.

82. From the preceding statement, the Carlisle Table of Mortality (No. II. in Mr Milne's *Annuities*, or No. V. at the end of the article ANNUITIES in this *Supplement*), and the Northampton Table (No. XVII. in Dr Price's *Observations*), we have derived the following.

Out of	Who attain the Age of	There die before the Age of	According to the Carlisle Table.	According to the Experience of the Equitable Society.	According to the Northampton Table.
Persons.	*Years.*				
6460	10	20	370	309	618
6090	20	30	448	443	886
5642	30	40	567	579	965
5075	40	50	678	652	1086
4397	50	60	754	900	1260
3643	60	80	2690	2244	2805

83. This Table shows, that the law of mortality exhibited in the Carlisle Table is almost exactly the same as that which has prevailed among the members of the Equitable Assurance Society. And although the members of such a society, when they first enter, are select lives, they are not, even then, so much better than the common average, as many persons suppose; for the more precarious a life is, the stronger is the inducement for parties interested in its continuance, to get it insured, so that bad risks are frequently offered to such companies. And many proposals for insurance are accepted by the directors, that are not thought very eligible at the time, in cases where they are not aware of any specific objection to the life proposed.

84. Besides, it is to be considered, that of the number in a society at any one time, but a small proportion can have been recently admitted, and in a few years from the time of admission, the members will generally have come down to the common average of persons of the same ages.

85. It ought also to be observed, that most of the tables of mortality that have been published, have been constructed from observations made upon the whole population of very large towns, such as London, Paris, Vienna, and Stockholm; in each of which there are particular quarters inhabited only by the very lowest of the people, who, unfortunately, are also very numerous, badly clothed and fed, therefore exposed to serious injury from the inclemencies of the weather; extremely ignorant and vicious, indulging in the abuse of spirituous liquors, and inattentive to cleanliness both in their persons and habitations; which last are crowded, badly ventilated, and surrounded with mud and the putrid remains of animals and vegetables. These are the nests of contagious diseases, in which they are generated and kept alive, where they at all times occasion great mortality, though not so much within the last 30 or 40 years as previously, and from which, when circumstances favour them, they spread among the rest of the people.

86. It is, therefore, obvious, that in such places, the average mortality at every age must be considerably greater than that which prevails only among the middling and higher classes of society even in such towns.

87. But the lives upon which leases, annuities, reversions, and assurances depend, are very seldom exposed to the influence of the causes of mortality mentioned in No. 85. Whence it follows, that a table of mortality on which those causes have had no great influence, is best adapted to the valuation of such interests.

And these kind of valuations are the most important purposes to which tables of mortality can be applied. (U.)

TABLE I.

In all Sweden and Finland during the Five Years ending with 1805.

Between the Ages of	Mean Number of the Living.		Annual average Number of Deaths.		That is, Males One of	That is, Females One of
	Males.	Females.	Males.	Females.		
0 and 1	44,536	43,847	11,132	9,238	4.00	4.74
1 — 3	85,548	86,533	4,113	3,752	20.79	23.06
3 — 5	84,854	85,909	1,857	1,771	45.69	48.57
5 — 10	170,878	171,343	1,919	1,743	89.04	98.30
10 — 15	161,613	160,777	872	797	185.33	201.72
15 — 20	140,467	144,782	799	795	175.80	182.11
20 — 25	132,414	143,012	1,018	927	130.07	154.27
25 — 30	120,349	130,183	977	978	123.18	133.11
30 — 35	108,804	118,978	982	1,056	110.79	112.67
35 — 40	100,293	111,158	1,078	1,150	93.03	96.06
40 — 45	94,497	103,711	1,293	1,324	73.08	78.33
45 — 50	82,258	91,932	1,442	1,255	57.04	73.25
50 — 55	71,899	81,265	1,811	1,582	39.70	51.36
55 — 60	54,543	64,127	1,768	1,666	30.85	38.49
60 — 65	42,847	51,938	1,931	2,015	22.19	25.77
65 — 70	30,923	40,414	1,942	2,242	15.92	18.02
70 — 75	20,945	28,615	2,138	2,620	9.79	10.92
75 — 80	11,009	15,660	1,627	2,135	6.76	7.33
80 — 85	4,452	6,817	994	1,452	4.47	4.69
85 — 90	1,214	1,988	352	561	3.45	3.54
above 90	268	468	102	207	2.62	2.26
Of all ages	1,564,611	1,683,457	40,147	39,266	38.97	42.87

The Numbers of Births during the same Five Years were,

Males.	Females.	Both.
275,599	263,812	539,411

TABLE II.

Exhibiting the Law of Mortality which prevailed in all Sweden and Finland, during the Five Years ending with 1805.

Age.	Males. Number who annually complete that Year.	Males. Number who annually die in their next Year.	Females. Number who annually complete that Year.	Females. Number who annually die in their next Year.	Both. Number who annually complete that Year.	Both. Number who annually die in their next Year.	Age.
0	10,219	2064	9,781	1712	10,000	1888	0
1	8,155	481	8,069	426	8,112	453	1
2	7,674	266	7,643	244	7,659	256	2
3	7,408	181	7,399	174	7,403	177	3
4	7,227	136	7,225	125	7,226	130	4
5	7,091	117	7,100	105	7,096	112	5
6	6,974	89	6,995	81	6,984	84	6
7	6,885	70	6,914	65	6,900	68	7
8	6,815	59	6,849	52	6,832	56	8
9	6,756	50	6,797	45	6,776	47	9
10	6,706	40	6,752	39	6,729	39	10
11	6,666	37	6,713	34	6,690	36	11
12	6,629	35	6,679	31	6,654	33	12
13	6,594	33	6,648	30	6,621	31	13
14	6.561	33	6,618	31	6,590	32	14
15	6,528	35	6,587	34	6,558	35	15
16	6,493	35	6,553	34	6,523	35	16
17	6,458	36	6,519	36	6,488	35	17
18	6,422	36	6,483	36	6,453	37	18
19	6,386	41	6,447	39	6,416	39	19
20	6,345	45	6,408	39	6,377	43	20
21	6,300	48	6,369	40	6,334	43	21
22	6,252	49	6,329	41	6,291	46	22
23	6,203	49	6,288	42	6,245	45	23
24	6,154	49	6,246	42	6,200	45	24
25	6,105	48	6,204	44	6,155	47	25
26	6,057	48	6,160	45	6,108	46	26
27	6,009	48	6,115	46	6,062	47	27
28	5,961	49	6,069	46	6,015	47	28
29	5,912	50	6,023	48	5.968	50	29
30	5,862	50	5,975	49	5,918	49	30
31	5,812	51	5,926	50	5,869	50	31
32	5,761	52	5,876	52	5,819	52	32
33	5,709	52	5,824	54	5,767	54	33
34	5,657	54	5,770	55	5,713	54	34
35	5,603	55	5,715	55	5,659	55	35
36	5,548	56	5,660	57	5,604	56	36
37	5,492	58	5,603	57	5,548	58	37
38	5,434	60	5,546	59	5,490	60	38
39	5,374	64	5,487	60	5,430	61	39
40	5,310	67	5,427	62	5,369	65	40
41	5,243	69	5,365	67	5,304	68	41
42	5,174	70	5,298	69	5,236	70	42
43	5,104	72	5,229	69	5,166	70	43
44	5,032	74	5,160	69	5,096	71	44
45	4,958	76	5,091	65	5,025	71	45
46	4,882	79	5,026	64	4,954	72	46
47	4,803	83	4,962	65	4,882	73	47
48	4,720	86	4,897	68	4,809	78	48
49	4,634	94	4,829	75	4,731	84	49

Age.	Males. Number who annually complete that Year.	Males. Number who annually die in their next Year.	Females. Number who annually complete that Year.	Females. Number who annually die in their next Year.	Both. Number who annually complete that Year.	Both. Number who annually die in their next Year.	Age.
50	4,540	103	4,754	83	4,647	93	50
51	4,437	108	4,671	88	4,554	98	51
52	4,329	109	4,583	88	4,456	98	52
53	4,220	109	4,495	90	4,358	100	53
54	4,111	109	4,405	92	4,258	101	54
55	4,002	110	4,313	97	4,157	103	55
56	3,892	116	4,216	102	4,054	109	56
57	3,776	122	4,114	106	3,945	114	57
58	3,654	127	4,008	110	3,831	118	58
59	3,527	130	3,898	115	3,713	123	59
60	3,397	136	3,783	124	3,590	130	60
61	3,261	137	3,659	131	3,460	134	61
62	3,124	137	3,528	135	3,326	136	62
63	2,987	133	3,393	138	3,190	136	63
64	2,854	140	3,255	142	3,054	140	64
65	2,714	143	3,113	146	2,914	145	65
66	2,571	142	2,967	148	2,769	145	66
67	2,429	147	2,819	151	2,624	149	67
68	2,282	150	2,668	155	2,475	153	68
69	2,132	159	2,513	160	2,322	159	69
70	1,973	168	2,353	169	2,163	168	70
71	1,805	163	2,184	178	1,995	171	71
72	1,642	158	2,006	177	1,824	168	72
73	1,484	155	1,829	179	1,656	166	73
74	1,329	153	1,650	175	1,490	165	74
75	1,176	147	1,475	169	1,325	158	75
76	1,029	135	1,306	156	1,167	145	76
77	894	124	1,150	143	1,022	133	77
78	770	113	1,007	141	889	127	78
79	657	104	866	132	762	118	79
80	553	97	734	125	644	112	80
81	456	89	609	112	532	100	81
82	367	78	497	96	432	87	82
83	289	62	401	87	345	74	83
84	227	53	314	70	271	62	84
85	174	41	244	62	209	52	85
86	133	34	182	44	157	38	86
87	99	25	138	34	119	30	87
88	74	21	104	25	89	23	88
89	53	15	79	20	66	17	89
90	38	11	59	18	49	15	90
91	27	8	41	14	34	11	91
92	19	6	27	11	23	9	92
93	13	5	16	7	14	5	93
94	8	3	9	4	9	4	94
95	5	2	5	2	5	2	95
96	3	1	3	1	3	1	96
97	2	1	2	1	2	1	97
98	1	1	1	1	1	1	98

TABLE III.

According to the Law of Mortality that prevailed in all Sweden and Finland during the Five Years ending with 1805.

Age.	Years in the average future Duration, or Expectation of Life. Males.	Females.	Both.	Age.
0	37.820	41.019	39.385	0
5	48.987	51.046	50.014	5
10	46.681	48.570	47.629	10
15	42.888	44.727	43.809	15
20	39.051	40.905	39.980	20
25	35.486	37.167	36.330	25
30	31.853	33.494	32.684	30
35	28.208	29.901	29.063	35
40	24.622	26.353	25.495	40
45	21.189	22.924	22.066	45
50	17.901	19.367	18.651	50
55	14.968	16.087	15.550	55
60	12.173	12.978	12.598	60
65	9.606	10.220	9 983	65
70	7.255	7.698	7.497	70
75	5.509	5.784	5.665	75
80	4.095	4.221	4.165	80
85	3.230	3.230	3.230	85
90	2.553	2.263	2.357	90
95	1.700	1.700	1.700	95

TABLE IV.

Showing the Number of Years in the Expectation of Life at every fifth year of Age, from Birth to 90 *Years; according to different Tables of Mortality.*

Age.	MORE CORRECTLY. A Carlisle.	B Deparcieux's Annuitants.	C Kerseeboom's Annuitants.	D Sweden and Finland. 1755—76.	E 1775—95.	F 1801—5.	Age.	LESS CORRECTLY. M Montpellier.	N Chester.	O Mankind in General. Lambert.	P Florencourt.	Q Breslaw.	R Northampton.	Age.
0	38.72	....	34.47	34.42	36.12	39.39	0	25.36	36.70	29.00	28.93	......	25.18	0
5	51.25	48.25	44.45	46.79	47.92	50.01	5	45.40	45.32	42.20	42.44	41.25	40.84	5
10	48.82	46.83	42.71	45.07	46.16	47.63	10	45.45	43.55	40.90	41.43	40.4 2	39.78	10
15	45.00	43.50	39.55	41.64	42.63	43.81	15	41.54	39.70	37.60	38.15	37.50	36.51	15
20	41.46	40.25	36.31	38.02	38.96	39.98	20	37.99	36.48	33.80	34.81	34.17	33.43	20
25	37.86	37.17	33.27	34.58	35.47	36.33	25	34.90	33.39	30.50	31.71	30.93	30.85	25
30	34.34	34.08	30.92	31.21	32.12	32.68	30	31.89	30.76	27.60	28.64	27.93	28.27	30
35	31.00	30.92	28.36	28.03	28.82	29.06	35	28.85	27.62	24.90	25.71	25.00	25.68	35
40	27.61	27.50	25.49	24.66	25.45	25.50	40	25.75	24.65	22.30	22.87	22.33	23.08	40
45	24.46	23.92	22.34	21.61	22.26	22.07	45	22.72	21.85	19.60	19.93	19.67	20.52	45
50	21.11	20.42	19.41	18.46	19.08	18.65	50	19.79	19.13	16.80	17.05	17.25	17.99	50
55	17.58	17.25	16.72	15.58	15.90	15.55	55	16.98	16.33	14.20	14.27	14.83	15.58	55
60	14.34	14.25	14.10	12.63	12.85	12.60	60	14.44	13.28	11.80	11.87	12.42	13.21	60
65	11.79	11.25	11.56	10.10	10.19	9.93	65	12.12	11.37	9.90	9.85	9.93	10.88	65
70	9.18	8.67	9.15	7.72	8.01	7.50	70	9.90	8.43	8.20	8.06	7.58	8.60	70
75	7.01	6.50	6.81	5.91	6.27	5.67	75	7.88	7.70	6.50	6.61	5.58	6.54	75
80	5.51	4.67	5.05	4.28	4.85	4.17	80	5.86	5.32	5.70	6.06	4.50	4.75	80
85	4.12	3.17	3.38	3.23	3.84	3.23	85	4.07	4.53	6.50	5.62	......	3.37	85
90	3.28	1.75	2.47	2.05	3.03	2.36	90	3.62	2.98	5.00	4.69	......	2.41	90

TABLE V.

Exhibiting the Law of Mortality that prevailed among the whole Population of Sweden and Finland, during the Five Years ending with 1805, *according to Two different Methods of constructing Tables.*

	More Correctly.		Less Correctly.				
	A	B	C	D	E	F	
Age.	Number who complete that year of their Age.	Number who Die in their next Year.	Number who Die in their next Year.	Out of the undermentioned Number who complete that Year, by Hypothesis.	Out of the undermentioned Number who complete that Year, by Observation.	Errors of the Hypothesis.	Age.
0	10,000	1888	2565	10,000	13,586	3586	0
1	8,112	453	625	7,435	11,192	3757	1
2	7,659	256	365	6,810	10,920	4110	2
3	7,403	177	261	6,445	10,916	4471	3
4	7,226	130	196	6,184	10,895	4711	4
5	7,096	112	144	5,988	9,123	3135	5
6	6,984	84	106	5,844	8,813	2969	6
7	6,900	68	84	5,738	8,524	2786	7
8	6,832	56	68	5,654	8,296	2642	8
9	6,776	47	59	5,586	8,506	2920	9
10	6,729	39	49	5,527	8,454	2927	10
11	6,690	36	43	5,478	7,991	2513	11
12	6,654	33	40	5,435	8,065	2630	12
13	6,621	31	39	5,395	8,330	2935	13
14	6,590	32	39	5,356	8,032	2676	14
15	6,558	35	39	5,317	7,308	1991	15
16	6,523	35	39	5,278	7,269	1991	16
17	6,488	35	39	5,239	7,230	1991	17
18	6,453	37	40	5,200	6,976	1776	18
19	6,416	39	44	5,160	7,239	2079	19
20	6,377	43	47	5,116	6,970	1854	20
21	6,334	43	49	5,069	7,218	2149	21
22	6,291	46	50	5,020	6,838	1818	22
23	6,245	45	50	4,970	6,939	1969	23
24	6,200	45	50	4,920	6,889	1969	24
25	6,155	47	49	4,870	6,417	1547	25
26	6,108	46	49	4,821	6,506	1685	26
27	6,062	47	49	4,772	6,320	1548	27
28	6,015	47	49	4,723	6,271	1548	28
29	5,968	50	49	4,674	5,849	1175	29
30	5,918	49	50	4,625	6,039	1414	30
31	5,869	50	50	4,575	5,869	1294	31
32	5,819	52	51	4,525	5,707	1182	32
33	5,767	54	52	4,474	5,553	1079	33
34	5,713	54	53	4,422	5,607	1185	34
35	5,659	55	54	4,369	5,556	1187	35
36	5,604	56	55	4,315	5,504	1189	36
37	5,548	58	56	4,260	5,357	1097	37
38	5,490	60	57	4,204	5,216	1012	38
39	5,430	61	60	4,147	5,341	1194	39
40	5,369	65	62	4,087	5,121	1034	40
41	5,304	68	65	4,025	5,070	1045	41
42	5,236	70	67	3,960	5,011	1051	42
43	5,166	70	68	3,893	5,018	1125	43
44	5,096	71	67	3,825	4,809	984	44
45	5,025	71	66	3,758	4,671	913	45
46	4,954	72	66	3,692	4,541	849	46
47	4,882	73	67	3,626	4,481	855	47
48	4,809	78	68	3,559	4,193	634	48
49	4,731	84	73	3,491	4,111	620	49

	More Correctly.		Less Correctly.				
	A	B	C	D	E	F	
Age.	Number who complete that Year of their Age.	Number who Die in their next Year.	Number who Die in their next Year.	Out of the undermentioned Number who complete that Year, by Hypothesis.	Out of the undermentioned Number who complete that Year, by Observation.	Errors of the Hypothesis.	Age.
50	4,647	93	81	3,418	4,047	629	50
51	4,554	98	85	3,337	3,950	613	51
52	4,456	98	86	3,252	3,910	658	52
53	4,358	100	87	3,166	3,792	626	53
54	4,258	101	87	3,079	3,668	589	54
55	4,157	103	86	2,992	3,471	479	55
56	4,054	109	86	2,906	3,199	293	56
57	3,945	114	86	2,820	2,976	156	57
58	3,831	118	86	2,734	2,792	58	58
59	3,713	123	89	2,648	2,687	39	59
60	3,590	130	95	2,559	2,624	65	60
61	3,460	134	98	2,464	2,530	66	61
62	3,326	136	100	2,366	2,446	80	62
63	3,190	136	101	2,266	2,369	103	63
64	3,054	140	103	2,165	2,247	82	64
65	2,914	145	103	2,062	2,070	8	65
66	2,769	145	104	1,959	1,986	27	66
67	2,624	149	105	1,855	1,849	— 6	67
68	2,475	153	106	1,750	1,715	— 35	68
69	2,322	159	109	1,644	1,592	— 52	69
70	2,163	168	116	1,535	1,494	— 41	70
71	1,995	171	121	1,419	1,412	— 7	71
72	1,824	168	122	1,298	1,325	27	72
73	1,656	166	121	1,176	1,207	31	73
74	1,490	165	119	1,055	1,075	20	74
75	1,325	158	111	936	931	— 5	75
76	1,167	145	101	825	813	— 12	76
77	1,022	133	94	724	722	— 2	77
78	889	127	87	630	609	— 21	78
79	762	118	82	543	530	— 13	79
80	644	112	77	461	443	— 18	80
81	532	100	69	384	367	— 17	81
82	432	87	62	315	308	— 7	82
83	345	74	55	253	256	3	83
84	271	62	47	198	205	7	84
85	209	52	38	151	153	2	85
86	157	38	28	113	116	3	86
87	119	30	21	85	83	— 2	87
88	89	23	15	64	58	— 6	88
89	66	17	12	49	47	— 2	89
90	49	15	9	37	29	— 8	90
91	34	11	7	28	22	— 6	91
92	23	9	6	21	15	— 6	92
93	14	5	5	15	14	— 1	93
94	9	4	4	10	9	— 1	94
95	5	2	3	6	8	2	95
96	3	1	2	3	6	3	96
97	2	1	1	1	2	1	97
98	1	1	0	0	0	0	98

TABLE VI.

Exhibiting the Expectation of Life in Sweden and Finland, btoh according to Columns A *and* D *of the preceding Table.*

Age.	A	D	Age.
	More Correctly.	Less Correctly.	
	Expectation of Life.		
0	39.385	30.863	0
5	50.014	45.719	5
10	47.629	44.361	10
15	43.809	41.019	15
20	39.980	37.531	20
25	36.330	34.299	25
30	32.684	30.983	30
35	29.063	27.650	35
40	25.495	24.382	40
45	22.066	21.294	45
50	18.651	18.159	50
55	15.550	15.384	55
60	12.598	12.562	60
65	9.933	9.978	65
70	7.497	7.536	70
75	5.665	5.752	75
80	4.165	4.259	80
85	3.232	3.361	85
90	2.357	2.770	90
95	1.700	1.167	95

TABLE VII.

Exhibiting the Increase of the Total Population of Sweden and Finland, and the Decrease of the Absolute Number above 90 Years of Age, as well as of the Proportion of the whole Population above that Age, throughout the latter half of the Eighteenth Century.

In the Year	Total Population of Sweden and Finland.	Number above 90 Years of Age.	That is, of 1,000,000.	Who were Born between the Years
1757	2,323,195	1609	693	1657 and 1667
1760	2,367,598	1574	665	1660 and 1670
1763	2,446,394	1515	619	1663 and 1673
Mean No. between 1776 and 1780	2,706,757	1082	400	1676 and 1690
1781 and 1785	2,823,826	1014	359	1681 and 1695
1786 and 1790	2,884,834	1072	372	1686 and 1700
1791 and 1795	2,974,447	907	305	1691 and 1705
In 1800	3,182,132	637	200	1700 and 1710
1805	3,320,647	837	252	1705 and 1715
	In Sweden alone.			
1810	2,377,851	574	241	1710 and 1720
	Total Population of the Spanish Dominions in the Old World.			In inserting the dates in this column, those who survived 100 years have been neglected, as inconsiderable in comparison with the rest.
1797	10,541,221	4549	432	
	In the Canary Islands only.			
1797	173,865	155	892	

(U.)

Mueller.

MUELLER (Johannes Von), the only author whom Germany can oppose to the illustrious historians of Italy and Britain, was born at Schaffhausen in 1752, of which town his father was a pastor. In 1769, he commenced his academical life at Gottingen, where he applied himself principally to theology; a study and a profession which he soon deserted. In 1772, he was appointed professor of the Greek language in the Gymnasium of his native town. In 1774, he removed to Geneva, where he principally resided till 1781. Here he delivered his lectures on Universal History, which were written originally in French; and here he formed the plan, and commenced the investigations towards his *History of the Helvetic Confederacy*. In 1781, he was called as professor of history to the Carolinum of Brunswick, an appointment which he soon abandoned; and, in 1782, he returned to Switzerland. By Heyne's recommendation, he was, in 1786, called as Librarian, with the title of Aulic Counsellor to Mentz. In 1800, he received the appointment of Librarian to the Imperial Library at Vienna; in 1804, was called as Historiographer and Counsellor of War to Berlin; and, in 1807, was appointed Minister, Counsellor of State, and General Director of Public Instruction in Cassel. Here he died in 1809.

To enter into any detail regarding the history of Mueller's life is here the less requisite, as there perhaps never existed an author whose internal character was more independent of outward circumstances, or in whom the writer was in a more remarkable manner distinguished from the man; while, at the same time, his writings breathe the whole energy of the deep feelings of his ardent disposition. An honest enthusiasm for truth and virtue was combined in him, with an ambition, which could be satisfied only with the renown of a great author. No exertion of intellect was for him too painful; no perseverance in industry surpassed his endurance. Of a cheerful disposition, even amid the adversities of life, he pursued without faultering his determined object. From the letters which in his youth he wrote to his friend De Bonstetten, we see him at the beginning, the same as at the termination of his course. But this very con-

sistency renders the contrast between the two characters which he united in his person, only the more remarkable. By nature amiable, but soft even to weakness, open and liberal, though without one conspicuous trait of magnanimity, accommodating himself to circumstances with the pliability of a courtier, and yielding to the seduction of his passions in a point where morality condemns him without appeal: yet, no sooner had he seized his pen—no sooner had he begun to narrate the great events of former times, than this man became a hero at once in firmness and elevation; and this not by any artificial discipline of his imagination, but from a genuine and resistless enthusiasm in his own moral delineations. It then became a necessity of his nature to think and to write as if he himself had been one of the mighty warriors or statesmen, to glorify whose names it was his chief delight; now a Roman, now a Switzer of the ancient time, and now some other illustrious personage, whose character he superinduced upon his own in the moment of description. Moral and political grandeur had indeed for him so strong a charm, that he frequently deceived himself in his estimate of their amount.

With such a character of mind, Mueller could never be a historian who wrote only for the intellect, and still less a historian who wrote only for the memory. All that he read of remarkable persons and events became, in his imagination, a series of animated pictures. He must represent and paint, and he painted with few strokes, and happily, as if from life; while truth, as far as this could be discovered by historical research, was of greater value in his eyes than all the ornaments of rhetoric. His imagination was only active to place what he read before him in a living form. His historical delineations were inspired with the warmth of his peculiar temperament, but not misrepresented. As he himself was animated by whatever was good, and generous, and great, so, too, he wished to animate his reader by a sympathy with his portraits, and through the instructions which history conveys. But in Mueller's view, history must be instructive in a degree of which few historians have any conception. His free and clear intellect, adhering to no philosophical system, and with little inclination towards the abstract sciences in general, but penetrating deeply into the internal connection of historical events, was able to extract from this connection political and moral principles, which, though manifest even to the unlearned reader, when placed before him, are overlooked even by the enlightened thinker, when his observation is not guided by the legitimate deduction of causes and effects. And in this historical deduction, if we except Thucydides and Tacitus, Mueller has no superior. Not that he is equal to these great originals, or even to some modern historians, in the detailed developement of events, and in the arrangement of circumstances in the order of their absolute and relative importance. For the adequate attainment of this great end Mueller was disqualified by a certain deficiency in the powers of abstraction and combination. The ideas, in his representation, display no regular subordination; they are frequently crowded together, transposed, or dragged behind. In this respect he is more peculiarly opposed to Tacitus, although the Germans have fondly styled him the twin brother of that great historian, who, in the distinction of what is principal and accessory, has no equal, and almost no likeness, among the historians either of ancient or modern times. Thucydides and Tacitus he more nearly resembles in the energy and laconic brevity of his style. Pleased only with a strength and fulness of thought, he abhors all that is empty, trivial, or redundant. Impelled by youthful enthusiasm to write the history of his native Switzerland, and dwelling, as it were, for years among the original documents from which his materials were compiled, his powerful style insensibly contracted a certain antique colouring from the language of the ancient chronicles; and thus it is that his diction more vividly expresses the character of that peculiar period, which, during the interval of composition, was then living in his own imagination. What was tasteless and offensive in the style of the old chronicles was indeed softened down in Mueller's cultivated mind; but while his intellect was engrossed with the connection of events, a laconic brevity had for his individual taste an irresistible charm, even when purchased at the expence of easy and natural expression. Mueller's *History of the Helvetic Confederacy*, the work on which he laboured longest, and to which he applied the whole force of his industry and talents, is the book in which we may best discover the spirit of his historical composition, in all its qualities both of comprehension and detail. But this work, one of the most singular products of great historical intellect, requires so close an attention to a multitude of small matters of fact, the details of which might easily have been omitted, and from the continued brevity, combined with the antiquated costume of the expression, exacts from the reader, unaccustomed to such a style, so vehement a stretch of thought, that we are ever and anon compelled to lay aside the book and breathe, in order to collect new strength for the perusal. Indeed, no book has, perhaps, been so much praised, and so little read, as the *Helvetic History* of our author. Mueller, who, from youth till death, and amid literary and political occupations of another kind, always considered the history of his native country as the principal object of his life, had so accustomed himself to that character of composition, which he thought accommodated to a history of Switzerland, that in his other writings, he is not wholly able to divest himself of its peculiarities. His *Universal History*, first drawn up in French, for a society of young persons who were his pupils at Geneva, afterwards with greater care re-written in the German tongue, and first published after the author's death, though comprising, in abridgment, all ancient and modern ages, is, however, far inferior in historical value to the history of Switzerland; but the nature of its subject is more agreeable to the majority of readers; and in the condensation of the matter, the style has a certain facility, in which we easily recognise the man to whom French was in his youth a second mother-tongue.

Of the other writings of Mueller, the most remarkable are the *Letters*, which were not written

for the world, but published after his death in the collection of his works, of which they occupy several volumes. From these letters we learn the character of the man on its fairest and most honourable side; and we likewise see how far his style is removed from the affectation with which he has so often been reproached. For in these letters, written rapidly, without premeditation, and to confidential friends, the historian of the *Helvetic Confederacy* is recognized in every sentence; and the absence of a smooth and polished diction is in itself an excellence, when contrasted with the paint of letters written for admiration and display.

MUTIS (JOSEPH CELESTINO), an eminent Natural Historian, but peculiarly distinguished for the ardour of his botanical researches; was a native of Spain, born at Cadiz, 6th April 1732. His parents were respectable inhabitants of that city, and conferred on him the best elementary education that could be acquired in Andalusia. His first instructions were received in the College of San Fernando, in his native city, from whence he removed to the University of Seville. In both these seminaries he was distinguished, as well by his application and talents, as by the modesty of his demeanour. He attended the classical and mathematical course as taught in the latter seminary, as well as to the study of theology; and during his residence there, sedulously applied himself to anatomy, medicine, and natural history. The ardour he displayed for this class of pursuits was great, so that, when he removed to Madrid in 1757, he had made such progress as to enable him to become a lecturer on anatomy. It was then usual for the Court of Madrid to select some promising young men, and send them to Leyden, Paris, or Bologna, to improve their faculties, and advance their knowledge of the sciences. Mutis was selected for this purpose, but about the same period Don Pedro Messia de la Cerda was appointed Viceroy of New Granada, and proposed to the ardent naturalist to accompany him, in the quality of physician, to that interesting country. His natural modesty and love of retirement induced him to relinquish the opportunity of visiting different countries, and thereby increasing his knowledge in Europe, and to devote himself to the examination and description of those objects of natural history which the mountains of South America presented, and which had previously been scarcely explored by any scientific European.

He embarked with the Viceroy, and landed at Carthagena in the year 1760. The various new productions that met his eye at every point in that hot climate, did not detain him from ascending towards the mountain plain, where at the city of Santa Fé de Bogota he fixed his abode.

He had scarcely reached the destined place of his residence, before he began to arrange his plan for the collection of those plants to whose study he was attached, and of which the descriptions formed the delight of his life, and the basis of his future fame. He soon began a correspondence with Linnæus, which continued during the life of that celebrated man, who procured his admission to the academy at Stockholm. His accuracy, diligence, and enthusiasm, were highly estimated by the Swedish botanist, who felt, in the eulogiums he paid him, that he very imperfectly gratified his own sentiments of respect and admiration.* His skill was speedily known through Europe by all the botanists of considerable eminence, as his discoveries were communicated to many of them, through the extensive correspondence which he maintained.†

At the time Mutis arrived at Santa Fé de Bogota, that capital was in profound ignorance of science, and, even in the university, the true system of the universe was so little known, that he is represented as having encountered great difficulties, when he first taught that the world turned on its own axis, revolved round the sun, and was in reality only a planet of the solar system. With the approbation of the viceroy, he began to dispense mathematical, and especially astronomical knowledge, to the pupils in the college of the Rosario; and he had the satisfaction, long before the close of a protracted life, to see a race of scholars formed on the principles of the Newtonian philosophy, in spite of the anxious and alarming fears of their parents, who, on its first introduction, considered it impious, or at least heretical.

He continued diligently exploring the Andes for every vegetable production, during the intervals of instruction in astronomy, and continued both pursuits with unabated ardour. When his patron Cerda had finished the period of his Viceroyship, he proposed to Mutis to return with him to Spain, but he was so much fascinated with the solitude of the vast woods and extended plains, with the features of nature displayed on the boldest scale, and the deep azure of the unclouded sky, that he determined, under their favouring auspices, to spend the rest of his life in South America, in the contemplation of vegetation, and of the starry world. His studies, instead of producing scepticism, strengthened his religious faith, and, under its influence, he entered into holy orders in 1772. From that period, he divided his time between religion and the sciences, and, whilst in the former he was a model of ecclesiastical virtue, he displayed in the latter the qualities of a genuine philosopher.

It was a fortunate circumstance, both for the science of botany, and for the fame of Mutis, that the Court of Madrid felt a peculiar interest in the promotion of that study, and appointed commission-

* In memoriam Josephi Cœlestini Mutis, Americes summi Botanici, qui historiam plantarum Americanum, in primis Palmarum, pulcherrimam parat, et plurima nova hinc opuscula communicavit. *Lin. Suppl.* p. 57. Nomen immortale quod nulla aetas unquam delebit. *Linn.*

† Cavanilles, in writing, thus expresses himself: "In honorem sapientissimi viri (J. C. Mutis) qui jure merito Botanicorum in America princeps salutatur, debetque etiam inter primates Europeos colocari."

Mutis.

ers in each of its extensive dominions in America to investigate, arrange, describe, and draw their various productions. Mutis was appointed president of the Botanical Board for the Viceroyalty of Santa Fé, and commenced his operations by the project of that great work the *Flora of Bogota*, which only the munificence of a government could enable him to undertake. In 1782, he selected the spot most favourable for executing this great design, and, judging the central situation of Mariquita, at the foot of the mountains of Quindiu, to be the best adapted for his purpose, he removed thither, and resided in that place for the succeeding seven years, in pursuance of his plan of study. The place was admirably chosen; for though at the foot of the Andes, it is on a high level, and in a temperate climate; and, being in the vicinity of the river Magdalena, though considerably higher, it has the advantage of easy access to every degree of temperature, and to all the various family of plants which the greatest possible differences of climate can produce. In this secluded town, he and his pupils were constantly employed in roaming in the extensive plains, penetrating the thickest woods, scaling the highest mountains, and at times encountering the severe heat of the valleys, whilst collecting every rarity of the vegetable kingdom. He there created a class of painters, who drew the plants as they were collected: he had a school of engraving, in which were executed some of those large plates, which have excited so much admiration among the botanists and artists of Europe. The state of his health, arising principally from the exertions he made, and the hardships he encountered in these pursuits, induced him to remove from Mariquita in 1772, and fix his residence again in the capital, to which he was also drawn by the desire of being nearer to a greater number of artists, than could be collected in the retired spot from whence his exploratory journeys had been directed. His labours in perfecting the *Flora* were continued with unabated industry till the end of his life, and after his decease the work was continued by some of his pupils; though it has received serious interruptions from the civil wars, in the course of which some of those appointed to continue it were cut off amidst the contests of the various revolutionary factions. Among these is particularly to be regretted Don Francisco Caldas, who was endeared to Mutis, and most nearly resembled him in his industry, and his attachment to the study of natural history. Besides the great work, the *Flora*, Mutis finished one on the history of the trees of the quina species, and exercised his great acuteness in the investigation of the varieties of that family, whose bark has introduced a new era in the practice of medicine.

Amidst his botanical labours, Mutis never neglected his astronomical observations and experiments. It had often been suggested by philosophers in Europe, that the moon had probably an influence on the barometer, similar to what it exercises on the tides. The situation of Santa Fé was favourable for a variety of experiments, which Mutis conducted, and by which he ascertained the fact so clearly, as to remove all doubts on the subject. He was instrumental in obtaining powers from Madrid for the construction of an observatory on the summit of the Andes, at a far higher elevation than any of the observatories of Europe are placed. He had remarked, that the blue of the firmament appears darker in proportion to the elevation at which the observer stands, and that on the highest attainable situations, the sky seems almost black; so that the stars shine with a brilliancy uninterrupted by clouds, and even in day-light, are visible without the help of glasses.

He deemed the position favourable for astronomical observations, and especially for those of the fixed stars; for being near the equator, it commanded a view of the constellations both of the northern and southern hemispheres; and from its height, the observer is little liable to interruption from intervening clouds, or to errors from the inconstancy of the refractions. At his earnest recommendation, and under his inspection, the observatory was begun in 1802, and finished in 1803. Some instruments were collected in the country, and others were ordered from Europe. The first were, as may be supposed, destitute of those improvements which have been more recently introduced; and it unfortunately happened, that some of those exported from Europe were lost on the passage. The apparatus had not been completed when Mutis died, and the political storms which have agitated that country have prevented the completion of the collection. The founder had, however, directed the course of observations to be prosecuted with as much attention as the imperfection of the instruments would admit. Though the wise intentions of Mutis have been delayed, we may hope they have not been frustrated, but may look forward to a time when the catalogue of fixed stars in the southern hemisphere shall be considerably augmented, and their positions determined with the greatest accuracy. In the mean time, some astronomical and meteorological observations have been made and published, in a periodical register, and the exact latitude and longitude of the observatory has been determined. Its elevation above the level of the ocean, as determined by barometrical observations, frequently repeated, is 9416 feet. As this observatory is the first erected in South America, as it stands much higher than any other that ever was constructed, if its advantages shall be properly improved, it will be a benefit to science, and a durable monument to the fame of its founder.

Mutis enjoyed good health through a long life, which was closed in a manner worthy of a philosopher and a Christian, without pain or struggle, 11th September 1808. He left various manuscript works on plants, on meteorology, and on mining; an herbarium of upwards of 20,000 plants, more than 5000 drawings of plants, and a large collection of woods, of shells, of minerals, and skins of animals. He had also a very extensive collection of oil-paintings, of all the various animals of the viceroyalty coloured, in exact conformity to nature. It was the last wish he expressed, that his valuable collections might furnish the basis of a national museum; but the turbulent season which commenced soon after his death,

Mutis.

and the unsettled state in which public affairs have since continued, have hitherto prevented the fulfilment of his wishes. See *El Espanol. Diario de Santa Fe.* (w. w.)

MYSORE, properly MAISOOR, a large province of the south of India, principally situated between the 11th and 15th degrees of northern latitude, and now surrounded by the British territories, subject to the presidency of Madras. This province consists of a high table land, elevated 3000 feet above the level of the sea, from which rise a number of lofty hills, containing the sources of many rivers, the principal of which are the Cavery, Toombuddra, Vedawati, Bhadri, Penar, &c. The climate of this elevated region is temperate and healthy to a degree unknown in any other track of similar extent within the tropics. The rainy season is here more moderate than on either of the sea coasts, but of much longer duration; and during other seasons of the year the verdure is frequently refreshed by enlivening showers. Its soil produces not only all the grains and vegetables of other parts of India, but also many of the fruits of Europe. The cultivation is also much aided by means of reservoirs and wells, from whence the farmers irrigate their fields and gardens. The inhabitants are in general Hindoos; but the country having been so often the scene of warfare, it is not nearly so populous as Bengal, and some other of the British provinces. It produces horses, cattle, sheep, and swine, but none of them of a good size. This province is divided into three districts, named Fatana, Nagara, and Chatrakal: each district is managed by an Amildar, who is an officer of justice, police, and revenue, and who is accountable for his conduct to the ministers of the Rajah, who are kept to their duty by the presence of the British resident.

As this province is now particularly connected with the British interests, and, from a rival state, is become one of our staunchest allies, it is requisite to enter at some length into its political history. The ancestor of the reigning family is said to have been the chief of a band of herdsmen, who emigrated with their flocks and cattle from the province of Gujerat, and were allowed to settle in Mysore. The first person of this tribe who distinguished himself was named Vijeya, in consequence of an act of bravery. He married the heiress of the *Wadiar*, or chief of the town of Caroogully and its dependencies, and succeeded his father-in-law. His immediate successors are not known; but, in the year 1507, Cham Raj took possession of the government, but still acknowledging himself as a subject of the Maha Rajah of Annagoondy, who was a descendant of the ancient Hindoo monarchs of Bijanagur. Tim Raj succeeded in 1548, and annexed some other districts to his government. Heere Cham Raj ruled from 1571 to 1576, and was succeeded by his cousin Raj Wadeyar, who appears to have taken advantage of the declining power of his lord paramount, not only to annex to his own estates those of the Rajah of Chickraipatam, but to take possession of the city and fortress of Seringapatam. This event occurred in the year 1610, and may be considered as the æra of their sovereignty. After this event, he subdued several of the neighbouring Wadeyars, and kept them in confinement at Seringapatam. He died in the year 1617, and was succeeded by his grandson Cham Raj, who added considerably to the Mysore territories, and died in 1637. He was succeeded by a posthumous son of the former Rajah, named Immadee Raj, who, in the course of a short time, was poisoned by his prime minister. Canty Revy Narsa Raj, second cousin of the deceased, was the next sovereign of Mysore. He made various conquests, and reigned till 1659. He was the first prince who established a mint, and coined the *fanams* and *pagodas*, still current, which go by his name. Dud Deo Raj was his successor; he made several conquests, and died in 1672. Chick Deo Raj mounted the throne in 1672, and died in 1704. This prince completed the subjugation of the turbulent landholders, made a number of prudent regulations which still exist; and, among other accessions, acquired by purchase the town and fortress of Bangalore. He also sent an embassy to the Mogul Emperor Aurungzebe, who conferred on him a splendid title, and granted him permission to sit on an ivory throne, which is still in existence, and was used on the late installation. Canty Raj, son of the last sovereign, mounted the throne in 1704. Having been born deaf and dumb, he was called the *Dumb Rajah*. It was in this reign that the great influence of the Dulwoy, or prime minister, commenced, which ever after rendered the Rajah a mere pageant. After a nominal reign of ten years, the Dumb Rajah died, and was succeeded by Dud Kishen Raj, who left the management of affairs entirely to his ministers, and died, after an inglorious reign, in the year 1731. He was succeeded by Cham Raj, who, not having been found of a sufficiently pliable disposition, was deposed and imprisoned by his ministers, in the year 1734. On this event, the Mysore ministers deviated from the regular line of succession, and chose a boy of five years old, of another branch of the royal family, named Chick Kishen Raj, to be the pageant of their government. The division of public business was at that period distributed in the offices of, 1st, Dulwoy, or commander-in-chief; 2dly, Serv Adikar, or comptroller of the revenue; and, 3dly, Purdhan, or privy counsellor. The first of these offices was held by Deo Raj, the second by Nunjeraje; but they subsequently exchanged appointments, and the influence of the latter was much increased by the marriage of his daughter to the young Rajah, in the year 1746. It was under the command of Nunjeraje Dulwoy, that a large Mysorean army marched to the assistance of the British, and their ally the Nabob Mohammed Aly, in the year 1753; but as the promised bribe, held out for his assistance (the cession of the fortress of Trichinopoly), was not complied with, he shortly after became their enemy, and for nearly two years laid siege to Trichinopoly; but, in the end, was compelled to abandon it, in consequence of the invasion of Mysore by an army of Mahrattas. From this period may be dated the decline of the minister's power, the downfall of the Hindoo dynasty, and the succession of a Mahometan usurper, whose history being not generally known, it is deemed requisite to insert an abridgment of it here.

The great-grandfather and grandfather of Hyder

Aly were both named Mohammed; they were religious persons, who emigrated from the Punjab, and settled in the vicinity of the tomb of Geeso Deraz, the famous saint of Kalberga. The son of the younger Mohammed was named Futteh Aly, who, having entered the army as a private soldier, rose by degrees to the rank of commander of a regiment, with the title of Naick. This person improved his fortune by marriage, but was killed in an engagement about the year 1729. Some time previous to his death, he had raised a mausoleum over his father, and his wife, in the vicinity of the town of Colar, and was buried there. After the battle in which Futteh Aly was killed, his family were taken prisoners, and plundered of every thing they possessed. The widow, accompanied by her two sons, Shabaz-Saheb and Hyder, boys, took refuge with her brother Ibrahim, who commanded a small body of *peons* or infantry, in the service of the governor of Bangalore. When the elder brother Shabaz had attained a sufficient age, his uncle procured for him a recommendation to an officer of rank in Seringapatam; and he was received into the service as a subordinate officer of infantry, in which situation he distinguished himself, and gradually rose to the command of 200 cavalry and 1000 infantry. It is probable, that Hyder profited by the good fortune of his brother, and was employed by him in a subordinate situation; but he does not appear to have distinguished himself till the year 1749, when, during the siege of Deonhally, by his intrepidity and skill, he attracted the attention of the Dulwoy Nunjeraje; and, upon the capitulation of the place, was promoted to the command of it, with a garrison of 200 infantry and 50 cavalry. Permission was also granted him to augment the number of troops, if he found it requisite. During the contest between the Nizam Nasir Jung, and his rival Muzuffir Jung, in the year 1750, Hyder Aly commanded part of the quota of Mysore troops, and distinguished himself in resisting the French column; but as soon as Nasir Jung was killed, he employed his followers in plundering the camp of his late master; and, amongst a number of other valuables, carried off two camels laden with gold, 300 horses, and 500 stand of arms, all of which he conveyed safely to Deonhally.

Hyder Aly was again employed at the siege of Trichinopoly; and during the battle of the 17th of August 1754, between the British and the French armies, with their allies on both sides, Hyder seeing the baggage of the British left without protection, ordered some of his troops to amuse the Tanjorine cavalry in front, whilst he with another body galloped round, and fell upon the rear of the convoy, amongst which he created great confusion, and seized 35 carts laden with ammunition and stores. On the retreat of the Mysoreans in 1755, Hyder was detached in the command of an army, consisting of 5000 infantry, 2500 cavalry, six guns, and a number of irregular troops, to secure the district of Dindigul. During the three years he continued in the government of Dindigul, he very considerably increased the number of his troops, disciplined his battalions, and took into his service several French artificers, under whose superintendence he formed a laboratory, arsenal, &c.

In the year 1758, a serious mutiny having broken out amongst the troops at Seringapatam, Hyder Aly was ordered to march thither with all his regular corps. Partly by fair means, and partly by force, he succeeded in quelling the mutiny, and in disbanding the army; in reward for which service, he was gratified with the fortress and adjoining district of Bangalore, as a fief or personal estate. In the following year, Hyder was invested with the command of all the troops employed against the Mahrattas, and was at the same time authorized to conclude a peace with them; but as this object could not be obtained without a large sum of money, and the government could not advance above half the amount, he was directed to borrow the remainder from the bankers; and in order to effect this, certain districts were assigned to him, to be held in pledge till the bankers should be reimbursed. Having appointed his own collectors to the districts, he borrowed the money, satisfied the Mahrattas, and returned in triumph to Seringapatam. His reception by the Dulwoy and young rajah was most gracious; by the former he was distinguished by the epithet of son, and by the latter honoured with the title of *Behauder* (the champion), which he ever after retained. In this sketch of the history of Hyder Aly, it is impossible to describe the various intrigues by which he subverted the authority of the Dulwoy (minister), and got the rajah completely into his own power. But his overweening confidence had nearly ruined him. In the month of May 1760, Hyder Aly was induced, by the intrigues of the French, to detach to their assistance almost the whole of the regular army then at Seringapatam; whilst he continued to reside in a garden a short distance from the city, with a guard of only 100 horse, and a battalion of infantry. The rajah and his mother, a woman of considerable talent, weary of the tyranny of their oppressor, entered into a secret treaty with a Mahratta chief, who was encamped on the frontiers, and who agreed to send, on an appointed day, 6000 chosen horse to their assistance; but owing to the procrastination of the Mahrattas, and an ill-timed attack from the foot on the cantonment of Hyder, he effected his escape with his hundred cavalry, attended by some camels laden with treasure, and succeeded in reaching the fortress of Bangalore, which was garrisoned by his own troops. This event took place on the 13th of August 1760. Immediately on Hyder's entering Bangalore, he sent off an express to recal the army from the Carnatic, under the command of his brother-in-law Mukhdum Sahib; and dispatched orders to the various detachments of his troops, dispersed over the country, to join him without loss of time. By degrees he was joined by his detachments, by new levies, by the Carnatic army, and by what was of great consequence, 200 French European cavalry, and 100 infantry, with some light artillery. With these forces, aided by intrigue, he defeated the Mysore troops in several engagements, and in the month of May 1761, again got possession of the person of the rajah. Hyder Aly, although now possessing all the real power of a sovereign, was still desirous of legalising his usurpation; he

Mysore.

therefore, by means of presents or concessions, received from the Nizam of the Dekhan a grant of the zemindary of Mysore, with a patent constituting him a *Heft Hazary*, commander of 7000 horse in the imperial service, and the title of Nabob Hyder Aly Khan Behauder.

In the year 1763, he conquered the countries of Bednoor, Soonda, and Canara; and in the three succeeding years, Calicut, and the greater part of Malabar. In 1766, the rajah Chick Kishen Deo died. When this circumstance was reported to Hyder, who was then at Coimbatoor, he ordered the funeral rites to be performed with all the usual ceremonies, and directed that the eldest son of the deceased, named Nunje Raj, should be placed on the throne, with the same parade and pomp as had formerly been used for his ancestors. Nunje Raj died, or was murdered, after a nominal reign of five years, and was succeeded by his younger brother Cham or Syama Raj, who, by the indulgence or policy of Hyder, was installed in the same manner as his predecessor.

In 1767, the Mahrattas and the Nizam, aided by a British auxiliary force, entered into an alliance against Hyder Aly. They in consequence invaded Mysore, and after having taken several of the fortresses, advanced towards Seringapatam. In this dilemma, Hyder ordered all the forage to be destroyed, and took post on the banks of the river Cavery, in an entrenched camp. After some days skirmishing, Hyder contrived, by his wonderful skill in politics, not only to make peace with the Mahrattas, but to conclude an alliance with the Nizam against the British. In virtue of this treaty, the allied forces invaded the Carnatic in September; and on the 26th of that month a general engagement took place in the vicinity of Erroar. The British gained the victory, by which the Nizam, being intimidated, was glad to make peace, leaving his ally to extricate himself in the best manner he could. Hyder, much mortified by this event, commenced a regular retreat to his own country, and was pursued by the British forces under General Smith. When both armies had advanced nearly to Seringapatam, Hyder leaving his infantry and artillery to continue the retreat, wheeled off with all his cavalry, turned the rear of the British army, re-entered the Carnatic, and in a few days was at the walls of Madras. By this manœuvre, he so intimidated the Madras government, that they were glad to make peace with him. The terms of the treaty were short and simple. All prisoners and places taken during the war were to be restored, freedom of trade was stipulated, and an offensive and defensive league concluded.

In the year 1771, Mysore was invaded by a powerful army of Mahrattas, who, after defeating Hyder, advanced to, and blockaded his capital; but fortune again favoured him, by the indisposition and death of the young Peishwa, by which event dissension was sown amongst the Mahratta chiefs, and enabled Hyder to bribe them to retreat. The years 1773, 1774, 1775, and 1776, were devoted to the disciplining of his army, and to the gradual extension of his territories to the north and west. This he was enabled to do by the dissensions of the Mahratta chiefs and the Nair princes.

In 1777, Cham, or Syama, the young Mysore Rajah, died without issue. Upon this occasion, Hyder ordered eight or ten boys, lineally related to the royal family, to be brought before him, and made choice of one of them, nearly in the same manner that Ulysses discovered Achilles. This boy, whose name was also Cham or Syama Raj, was the father of the present Rajah.

By the treaty made with Hyder in 1769, the British had agreed to assist him against all his enemies; but when called upon to act against the Mahrattas in 1771, they had declined, and from that period Hyder harboured the most bitter hatred against them. The year 1779, when the British had quarrelled with the Mahrattas, and given offence to the Nizam, seemed a favourable opportunity of satiating his revenge; he therefore, by means of his emissaries, concluded an alliance with the above mentioned powers, and invited every other sovereign in Hindostan to join the confederacy, and to make a simultaneous attack on the British territories in their respective vicinities. In conformity with this plan, Hyder Aly entered the Carnatic in the month of July 1780, at the head of an army consisting of 30,000 cavalry, and 40,000 infantry, with a numerous train of artillery, aided by a corps of Europeans, and a number of French officers. Hyder commanded in person the centre or main body. The left wing was under the orders of his son Tippoo Sahib, and was destined to attack the northern Circars; while the right wing, under one of his most esteemed generals, penetrated into Madura and the southern districts. During Hyder's former invasion of the Carnatic, in 1767, he had caused his army to refrain from atrocities, and to treat the prisoners with gentleness; but on this occasion he boasted, "that he was the engine of God's wrath, for the punishment of the people of the Carnatic." His army was, therefore, guilty of the greatest cruelties, laying waste the whole of the country with fire and sword; not only the military who were taken prisoners, but the peaceable inhabitants of the villages, were driven off like flocks of sheep to Mysore. The boys were made Mahometans, and the girls disposed of as slaves.

Notwithstanding Hyder was frequently defeated by the British forces under Sir Eyre Coote, his numerous cavalry and well equipped artillery enabled him to overrun the country at pleasure, and left no part of it in the possession of his enemies, except Madras, and some other fortresses. This system of warfare continued till the death of Hyder, which took place in the city of Arcot, on the morning of the 7th December 1782, at the age of 64 years. At the period of Hyder's decease, his dominions, exclusive of his conquests in the Carnatic, comprehended nearly 80,000 square miles; his territorial revenue amounted to two millions sterling. Although his army consisted of 150,000 men, his treasure contained several millions in bullion and specie.

Tippoo Sultan, the eldest son of Hyder, having joined the army on the 2d January 1783, quietly

succeeded to the empire of his father. A feeble attempt had been made in favour of the second son, called Abd al Kereem, now a state prisoner in Calcutta, but was considered of so little consequence, that the tyrant never attempted the life of his brother, who either was, or pretended to be deranged, and always wore the dress of a *fakeer*, or hermit.

The invasion of the western or Malabar coast by the British, and the capture of Bedenoor, compelled Tippoo to relinquish the views of his father on the Carnatic, and to proceed with all expedition to the defence of his own territory. He left Arcot early in March; and having, in the course of the month of April, reached Bedenoor, he compelled General Matthews to capitulate. The principal articles of the capitulation were, that the garrison were to pile their arms on the glacis, but to retain all their private property; they were then to be marched, by the shortest route, to the sea side, and thence to be embarked for Bombay. But Tippoo, under pretence that the public treasure had been made away with, caused all the prisoners to be plundered. They were afterwards fettered, and then dispatched to different fortresses, where most of them died through hard treatment; the general and several of the principal officers were beheaded.

After this event Tippoo marched to the seaport of Mangalore, but was baffled in the siege of that place, till, in consequence of the peace between England and France, the French auxiliaries having declined any further co-operation with him, and the recent successes of the British in other parts of the country, compelled him to make peace. On the 11th of March 1784, a treaty was concluded between Tippoo and the British, the principal articles of which were, that all the places taken by either party during the war were to be restored, and that all the prisoners on both sides were to be released.

Tippoo being now at liberty, employed the remainder of 1784 in the complete subjugation of the Nairs of Malabar, and the conquest of the Coorg country. Having thus vanquished or made peace with his enemies, he returned in triumph to Seringapatam; when, feeling himself perfectly established, and his authority acknowledged, both by his subjects and the neighbouring powers, he ostentatiously mounted the throne, and assumed the title of Sultan, thereby throwing off all allegiance to or dependence on the Rajah of Mysore or the Emperor of Hindostan; for although the name Sultan may have been given him at his birth, it certainly was never used as a title during his father's lifetime.

During the years 1785, 1786, and 1787, Tippoo *was engaged in hostilities against the Mahrattas and* the Nizam, in which victories were gained and defeats sustained by both parties; but the general result was in favour of the Sultan. The year 1788 was occupied by Tippoo in reforming the province *of Malabar, and the forcible conversion of the* inhabitants to the Mahometan religion. In the following year he invaded the territories of the Rajah Travancore, who being one of the British allies, applied to them for assistance, which circumstance brought on the subsequent war, at the conclusion of which, in March 1792, Earl Cornwallis, at the head of the allied forces, compelled Tippoo Sultan to pay the sum of four millions of money, and to relinquish the half of his dominions.

In the year 1796, the Mysore Rajah Cham Raj died, leaving an only son, then two or three years old, to inherit the dignity of his ancestors; but the haughty Sultan would not condescend to acknowledge even a nominal superior; and so far from exalting the boy to the throne of his forefathers, he barely allowed him to exist, in squalid poverty and humiliating contempt. From this period till the year 1799, Tippoo was engaged in constant intrigues with the French, and all the powers of Hindostan, in order to raise a confederacy against the British nation. His correspondence was detected by the Governor-general, Lord Mornington, now Marquis Wellesley. War was determined on; the British forces, with their allies, under the command of General Harris, marched to Seringapatam, and on the 4th of May 1799 put an end to the empire and life of Tippoo Sultan.

It would have been no less unjust than impolitic for the British either to have taken possession of the whole of the conquered territory for themselves, or to have restored the family of Tippoo to power. It was therefore determined to place on the throne Krishna Odiaver, the son of the last Rajah, a boy of five years old; to remain in possession of the ancient capital of Mysore, with a territory surrounding it equal to that possessed by any of his ancestors, and yielding a revenue of L. 1,030,000 sterling, with the entire management of the country by his own officers; but subject to the general superintendence of a British resident.

On the 30th day of June 1799 the ceremony of installing the young Rajah took place, in a temporary building erected for the purpose in the old fortress of Mysore. It was attended by the British Commander-in-chief, by many of the principal officers of the allied forces, and by an innumerable multitude of Hindoos, who testified their most unfeigned delight on beholding a person of their own religion, the orphan of a much injured family, restored to the possessions of his ancestors. Previous to the installation pensions had been granted to most of Tippoo's officers, and the family of the Sultan were sent as *state prisoners to Vellore, whence they were subsequently removed to Calcutta, where they now reside* upon liberal allowances, and enjoy a degree of freedom much greater than would have been their lot, had these events not taken place.—(*Edinburgh Gazetteer, or Geographical Dictionary*, Vol. IV. *Part II.*)

ADDENDUM

TO

VOLUME FIFTH.

MOLLUSCA.*

THE primary division of animals into VERTEBRAL and INVERTEBRAL, indicated in the writings of the ancients, by the terms sanguineous and exanguineous, possesses many advantages, and now appears to be universally adopted by zoologists. Among the vertebral animals, the brain is collected into one mass at the anterior extremity of the body, and sends out a nervous cord, termed the spinal marrow, to the posterior extremity. These nervous portions are protected by a cranium and vertebral column.

The invertebral animals occupy a lower station than those belonging to the vertebral group. Their nervous system, in particular, is less fully developed, and their organs of perception are greatly reduced in number. They may be distinguished readily by the following negative character:

INVERTEBRATA.

Invertebral Animals.

ANIMALS DESTITUTE OF A SKULL AND VERTEBRAL COLUMN FOR THE PROTECTION OF THE BRAIN AND SPINAL MARROW.

The invertebral animals have few characters of a positive kind, which they possess in common. The skin, in general, consists only of a corium and cuticle, both of which, according to circumstances, are furnished with appendices, in the form of shells, crusts, scales, or hairs. These, in general, supply the place of the osseous system, serving as a protection to the viscera, and as supports to the muscles. The blood, in those cases where a circulating fluid can be detected, is usually of a white or grey colour, seldom inclining to red. When there are both systemic and pulmonic ventricles, they are not united as in the vertebral animals. With the exception of the genuine viviparous mode of reproduction, the invertebral animals exhibit all the other modifications of that function.

In attempting the division of invertebral animals into subordinate groups, the condition of the nervous system furnishes characters of importance. In one extensive class, which, from their starry form, have been termed RADIATA, the nervous matter appears to be disseminated among the different organs, and never appears in the form of a brain, with its connected filaments. In another class, equally extensive, and which, with propriety, may be denominated GANGLIATA, the brain appears in the form of a collar, surrounding the gullet, near its entrance into the stomach, and sending out filaments, which, in their course, expand into ganglia. In this last group are included the classes *Annulosa* and *Mollusca*. The classification of the *Annulose* animals has been already communicated to our readers. The *Molluscous* tribes now claim our attention. The essential characters, by which these two classes may be distinguished, depend on the condition of the nervous filaments proceeding from the brain; the principal of which, in the former, constitute a knotted cord proceeding to the extremity, while, in the latter, they separate irregularly.

* See the word MOLLUSCA, p. 490 of this Volume.

Independent of this internal character, molluscous animals are distinguished from those of the annulose division by the absence of articulated feet, or the cuticular processes which supply their place, and by the body not being divided into joints or rings.

Under the article CONCHOLOGY, a variety of details were given regarding the shells of molluscous animals, the characters furnished by these appendices of the skin which have been employed in their classification, the relative value of the different popular systems which have been proposed, together with some remarks on the physical distribution of the species, and the revolutions which, in former ages, they have experienced. The present article may, therefore, be regarded as a continuation of the one dedicated to Conchology, and as having more immediately in view the exposition of those characters which are now employed in the most approved systems of zoology.

Molluscous animals divide themselves into two great divisions, which are distinguished from each other by well defined characters. In the first the presence of a head may be recognised, together with eyes and even ears, in some of the groups. In the other, containing animals much less perfect in their organization, there is no head, nor vestiges of eyes or ears in any of the groups. The former have been termed *Mollusca cephala*, the latter *Mollusca acephala.* This arrangement was first employed by the celebrated M. Cuvier, and afterwards by Lamarck and other modern systematical writers. In the last work of the former naturalist, this method is departed from, and six orders are now constituted of equal rank, instead of being placed subordinate to the two primary divisions, under which, notwithstanding, they can be suitably distributed.

I. DIVISION.

MOLLUSCA CEPHALA.

Head distinct from the body, bearing the lips or jaws.

The head, or the anterior part of the body, on which zoologists have bestowed that denomination, possesses more or less freedom of motion, and, on the dorsal aspect, supports either tentacula or eyes, frequently both. The animals of this division exhibit so many modifications of form and structure, in all the series of organs, that the positive characters which they possess in common are few in number. They easily admit, therefore, of subdivision into inferior groups, which exhibit well marked characters of distinction. Two of these groups occupy a primary rank, and admit of the others being included under them as subordinate sections. In the first of these, the animals are all inhabitants of the water, and perform their progressive motion through that element by organs fitted for swimming. They are destitute of any ventral disc on which to crawl. In the second group, including animals which inhabit the land, as well as those which live in fresh water and in the sea, progressive motion is performed by means of crawling along the surface of objects, the body resting on a ventral disc, termed a foot.

I. Section.

NATANTIA.

ORGANS OF PROGRESSIVE MOTION FITTED FOR SWIMMING.

The organs of motion are situated near the anterior extremity of the body, and either consist of flexible tentacula, or membranaceous expansions. All the species reside in the sea. They are nearly of the same specific gravity with the surrounding fluid, in which they float about, having their motions in a great measure regulated by its changes. It is however probable, that, by means of some contractile movements, they are capable of varying their density, and of rising or sinking in the water. They swim slowly, even with their utmost efforts. M. Cuvier has distributed the animals of this subdivision into two classes, which he has termed Cephalopoda and Pteropoda.

I. Class.

CEPHALOPODA.

Fins in the form of tentacula, surrounding the mouth.

Cephalopodous animals consist of a body and head The body is surrounded by a sac or tunic, closed posteriorly, and in part open anteriorly, for the orifices of the several organs. This tunic differs greatly in its texture, and is strengthened internally by testaceous or corneous productions, or externally by means of a spiral shell. The neck is more or less distinct from the sac. The head is flattened into a disc, in the centre of which is the mouth, and, towards the margin, the tentacula take their rise. The two Linnæan genera, Nautilus and Sepia, comprehend all the animals which are at present considered as belonging to this class.

I. Order.

NAUTILACEA.

Furnished with a multilocular shell.

This order is involved in the greatest obscurity. None of the recent species have been subjected to an accurate examination, so that their connection with the order sepiacea may still be considered doubtful. Enough is known of the animals of two of the genera, to furnish some hints for those who are fond of classifying animals from their analogies. These genera are SPIRULA and NAUTILUS.

In the *Spirula,* the shell, which is concealed under the skin of the back, is spiral, with the whorls separate, the mouth orbicular, the chambers perforated by a pipe, and the last cell produced into a tube. The position and use of this terminal tube are unknown. The *S. vulgaris* is the most common species, and inhabits the seas in the West Indies. In the restricted genus *Nautilus,* the shell is supposed to be external, and the body of the animal to be lodged in the last chamber, and to be fixed by a ligament which descends into the central pipe. In the shell itself, the turns of the spire are contiguous, and the last whorl embraces the others on the sides.

The *N. pompilus* of Rumphius is the only species in which the animal has been detected.

The other genera which have been formed in this order depend exclusively on the characters furnished by the shells, and the resemblance which these bear to the preceding genera constitutes all their claim to be included in the present order. (See CONCHOLOGY, Genus 18, *Nautilus.*)

II. Order.

SEPIACEA.

Destitute of a multilocular shell.

The sac is strengthened by horny or testaceous plates, unless where the habits of the animal render such support unnecessary.

1. HEAD SURROUNDED WITH EIGHT ARMS AND TWO FEET.

The two feet are nearly similar in their structure to the arms, or tentacula, but considerably larger in their dimensions. They have their organ on the ventral side of the mouth, between that organ and the funnel. The suckers are pedunculated, with their margin strengthened by a corneous ring, furnished with teeth. The sac is furnished with fin-like expansions, and strengthened internally by corneous or testaceous ribs or plates. The head is divided from the sac on all sides by a neck. The margin of the anus is surrounded with tentacula.

Genus, *Sepia.*—The sac is furnished on each side throughout its whole length with a narrow fin.

The suckers are irregularly scattered on the arms and feet. The back is strengthened by a complicated calcareous plate, lodged in a peculiar cavity. This plate has been long known in the shop of the apothecary, under the name *Cuttle-fish bone,* and belongs to the species termed *S. officinalis.*

Genus, *Loligo.*—Calamary. Sides of the sac only furnished partially with fins.

The suckers are disposed on the arms and feet in a double row. The dorsal plate is flexible and corneous, imbedded in the substance of the sac, and is multiplied with years. The *Sepia loligo* of Lin. is the type of the *genus.*

Dr Leach has described three new species of the genus Loligo, which were collected by Mr Cranch during the voyage to the Congo, in the unfortunate expedition under the direction of Captain Tuckey. These species belong to a group which have the suckers produced into hooked processes. In two of these species, *L. leptura* and *Smithii*, the suckers on the arms, as well as the feet, are produced into hooks, while, in one species, *L. Banksii*, the feet only are armed with hooks.

The same distinguished naturalist has instituted a new genus nearly allied to Loligo, from two species collected during the same voyage. The following characters are assigned to it.

"Genus, *Cranchia.*—Body oval, sack-shaped; fins approximating, their extremities free; neck with a frenum behind, connecting it with the sack, and with two other frena, connecting it with the sack before.

"Sp. 1. *Cranchia scabra.*—Sack rough, with hard rough tubercles.

"Sp. 2. *Cranchia maculata.*—Sack smooth, beautifully mottled with distant ovate spots." *

HEAD SURROUNDED WITH EIGHT ARMS WITHOUT FEET.

The suckers have soft margins. The sac is destitute of fin-like expansions, and is either simple or strengthened in the interior by two short corneous processes. The head is united with the sac behind, without the intervention of a neck.

Arms all equal in Size.

Genus, *Octopus.*—Suckers arranged in a double row.

The suckers are sessile. The oviduct is double. The margin of the anus is simple. The *Sepia octopodia* of Lin. is the type of the genus.

Genus, *Eledona.*—Suckers on the arms disposed in a single row.

M. Lamarck has figured and described two species of this genus, in the *Mem. de la Soc. d'Hist. Nat.* One of these is a native of the Mediterranean, and is remarkable for giving out an odour like musk.

Arms Unequal.

Genus, *Ocythoe.*—Two of the arms at their inner extremities furnished with membranaceous expansions.

In this genus, which was instituted by M. Rafinesque, the suckers are in a double row, and supported on footstalks. In the specimens of the *Ocythoe Cranchii,* procured during the expedition to the Congo, Dr Leach observed "four oblong spots on the inside of the tube, resembling the surfaces for the secretion of mucus, two inferior and lateral, and two superior, larger, and meeting anteriorly. On the rim of the sac, immediately above the branchiæ, on each side, is a small, short, fleshy tubercle, which fits into an excavation on the opposite side of the sac." *Phil. Trans.* 1817.

This animal was long considered as the fabricator of the shell termed Argonauta or Paper Nautilus. The observations, however, of Mr Cranch, the Zoologist to the Congo Expedition, have demonstrated that the shell is merely the temporary residence of this animal, which it quits at pleasure. "On the 13th of June," says Dr Leach, "he placed two living specimens in a vessel of sea-water; the animals very soon protruded their arms, and swam on and below the surface, having all the actions of the common *Polypus* (octopus) of our seas; by means of their suckers, they adhered firmly to any substance with which they came in contact, and when sticking to the sides

* *Narrative of an Expedition to Explore the River Zaire, usually called the Congo, in South Africa, in 1816, under the direction of* Captain J. K. Tuckey, R. N. London, 1818, p. 410.

of the basin, the shell might easily be withdrawn from the animal. They had the power of completely withdrawing within the shell, and of leaving it entirely. One individual quitted its shell, and lived several hours swimming about, and showing no inclination to return into it; and others left the shells as he was taking them up in the net. They changed colour, like other animals of the Class Cephalopoda; when at rest the colour was pale flesh-coloured, more or less speckled with purplish; the under parts of the arms were bluish-grey; the suckers whitish." The specimens which furnished an opportunity for making the preceding observations were met with in the Gulf of Guinea, and afterwards on the voyage, swimming in a small argonauta, on the surface of the sea. The reader, who is desirous of farther information on this subject, may consult Dr Leach's *Observations on the Genus Ocythoe* of Rafinesque, and Sir E. Home on the *Distinguishing Characters between the Ova of the Sepia, and those of the Vermes Testacea that Live in Water*, in the *Philosophical Transactions* for 1817, Art. xxii. and xxiii. (both of which are added to the appendix of Captain Tuckey's *Narrative*), and a paper by Mr Say on the Genus Ocythoe in the *Phil. Trans.* 1819, Art. vii.

II. Class.

Pteropoda.

Fins formed of membranaceous expansions.

M. Cuvier, whose valuable papers on the Genera Clio, Pneumodermon, and Hyalea, include nearly all the accurate information which naturalists possess, divides the animals of this class into cephalous and acephalous. In the latter division he places the genus Hyalea. The head of the animal of this genus, with its inferior neck, may, however, be sufficiently recognized to remove all doubt of its existence.

The characters which may be employed in the classification of this group are numerous; but the influence which their different forms exercise on the habits of the species is still unknown. The following disposition of the genera, though it has no claims to a natural division, may be useful to the student in his investigations.

I. Tunic Strengthened by a Shell.

Genus, *Limacina*.—Posterior extremity of the body covered by a spiral shell.

The shell, which is very tender, makes one turn and a half, is flat on one side, with a large pillar cavity on the other. The fins are two in number, seated on each side of the neck. When the animal swims, the head with the fins are protruded.

This genus was instituted by Cuvier, for the reception of the *Clio helicina* of Captain Phipps, or Argonauta arctica of Fabricius. According to Mr Scoresby, it is found in great quantities near the coast of Spitzbergen.

Genus, *Hyalea*.—Posterior extremity of the body protected by two connected shelly valves.

The *Hyalea tridentata*, the best known species of the genus, was first noticed by Forskael, in his *Descriptiones Animalium*, p. 124, as an anomia, and inhabiting the Mediterranean. The same species was likewise taken in abundance in the Gulf of Guinea, by the expedition under Captain Tuckey.

II. Tunic Destitute of a Shell.

A. Fins double.

Posterior Extremity with Leaf-like Ridges.

Genus, *Pneumodermon*.—Head with two bundles of tentacula.

The body is oval, with a narrow neck, and a fin on each side. The mouth is nearly terminal, furnished on each side with a fleshy lip, and beneath, with a fleshy chin. The tentacula consist each of a filament, with a tubercle at the end, pierced by a small hole, and considered as exercising the office of a sucker. M. Cuvier has figured and described the only known species, which he terms *Pneumodermon Peronii*, the trivial name being in honour of the discoverer, M. Peron.

Posterior Extremity Simple.

Genus, *Clio*.—Body ovate, with the tunic elongated and membranaceous.

The head is divided into two lobes, the summits of which are furnished with tentacula. The existence of eyes has not been ascertained. The *Clio Borealis*, a native of the Arctic Seas, is the type of the genus.

Genus, *Cleodora*.—Body covered with a triangular pyramidal tunic.

The fins are membranaceous. The mouth is situated between them, and is furnished with a semicircular lip. This genus was instituted by Peron, for the reception of the Clio of Brown. The *C. pyramidata* is the best ascertained species. Brown's *Jamaica*, p. 386, Tab. xliii. f. 1. Two other species were taken by the Congo expedition in S. Lat. 2° 14′, and E. Long. 9° 55′, and S. Lat. 2° 41′ E. Long. 9° 16′, "both having a spinous process on each side of their shell, near its opening. One species is beautifully sulcated transversely, and the other but slightly so." Tuckey's *Narrative*, p. 412.

B. Fin single.

Genus, *Cymbulia*. — Tunic cartilaginous and trough-shaped.

The fin is single, divided into three lobes, one of which is small, with two tubercles, and a minute fleshy beard. This genus was instituted by Peron, in *Annales du Museum*, T. XV. T. iii. f. 10, 11.

II. Section.

GASTEROPODA.

Organs of Progressive Motion fitted for Creeping.

This is one of the most extensive groups of Molluscous animals. The marks by which it is distinguished are well defined, and the external and internal characters of the species have been successfully illustrated.

The Gasteropoda may be considered as having the body protected dorsally by the cloak, and ventrally by the foot. The *cloak* is either *continuous*, and usually more or less arched for the reception of the viscera underneath, or it is *interrupted* by a pro-

Mollusca. jecting bag, in which are contained the principal digestive and reproductive organs. This projecting bag is tapering and spiral, and always protected externally by a shell. When the cloak is continuous, the surface is variously marked, and frequently exhibits a particular portion, more elevated than the rest, in some cases concealing a testaceous plate, which has been termed the *shield*.

The *foot*, situate on the ventral surface, and in opposition to the cloak, exhibits a flat soft surface, consisting of interlaced muscular fibres. Its central surface serves as support to the viscera, while externally it constitutes the organ of progressive motion. It is a *sucker* rather than a foot, and enables the animal to adhere to objects when at rest, and to crawl from one place to another by a succession of adhesions, not unlike the leech. It is also used as a fin in swimming.

By the union of the cloak and foot, laterally and posteriorly, a sac is formed, which is open in front for the protrusion of the neck and head. The line of junction between the cloak and foot is marked, in general, by peculiarities in the condition of the margins of both.

The *neck* is usually divided from the cloak by a *collar*, or thickened margin belonging to the latter, or rather to the shield, while in other cases it is continuous. Underneath, the neck is frequently attached to the foot.

The *head* supports the tentacula and eyes, is free dorsally, but frequently intimately connected with the foot on its ventral side. The portion between the tentacula and the mouth is termed the *snout* (*le mufle* of the French, and its margin *le chaperon*). The mouth exhibits various modifications of fleshy lips and corneous jaws. The inside of the cheeks are covered in some species with reflected teeth to aid deglutition. The *tongue* can scarcely be detected in some of the genera, while in others it is a simple tubercle, or a strap-shaped, spiral organ, armed with transverse rows of teeth. This spiral tongue, where it is fixed to the base of the mouth, is broadest, and there also the spinous processes are strongest. The spiral part is narrowest and softest, and folded up behind the pharynx. M. Cuvier conjectures, and apparently with plausibility, that the spiral portion comes forward into the mouth to act as a tongue, in proportion as the anterior part is worn by use and absorbed. (See his *Memoire sur la Vivipare d'eau douce*, p. 12.)

The organs of respiration exhibit the two modifications of lungs and gills, and enable us to divide the gasteropoda into two classes, which we have termed Pulmonifera and Branchifera. M. Cuvier appears to have been in some measure aware of the importance of the distinction when he instituted his order *Pulmonés*, but he afterwards suffered himself to be more influenced by the presence of an operculum, the shape of the aperture of the shell and the supposed separation of the sexes, than by the characters of the respiratory organs.

I. Class.

Pulmonifera.

The pulmonary cavity is single and lateral. Its orifice is capable of being closed at the will of the animal. The blood-vessels are spread, chiefly on the walls and roof, like delicate net-work.

The reproductive system of the animals of this class exhibits the sexual organs, in general, united in the same individual. Mutual impregnation, however, is necessary. All the species are oviparous. The eggs are either naked, as in the terrestrial genera, or enveloped in a gelatinous mass like the aquatic kinds. The embryo acquires nearly all its members while in the egg, and the shell is of a proportional size previous to hatching. Sir Everard Home, when treating of the distinguishing characters between the ova of the sepia, and those of the vermes testacea, that live in water (*Phil. Trans.* 1817, p. 297), and when referring to the ova of the vermes testacea, says, "If the shell were formed in the ovum, the process of aërating the blood must be very materially interfered with, for this reason, the covering, or shell of the egg, first drops off, and the young is hatched before the shell of the animal is formed; this I have seen take place in the eggs of the garden snail, but in the testacea that live in water, the young requires some defence in the period, between the egg being hatched and the young acquiring its shell, which is not necessary in those that live on land; for this purpose, the ova are enclosed in chambers of a particular kind." The assertion here made, and founded on *a priori* considerations, that the shell is not formed until after the egg is hatched, is opposed by every observation which we have been able to make on the subject; and what is more surprising, it is at variance with his own observations on the garden snail, the very example produced in its confirmation. The eggs of a snail laid on 5th August 1773 were hatched on the 20th of that month, and their condition at this time distinctly stated. "On the 20th, the young were hatched, and the shells completely formed." It is much more becoming, in a philosopher, to observe how nature operates, than to pronounce what she *must* do.

I. Order.

Terrestrial.

The animals of this order reside constantly on the land. When by accident they fall into the water, they appear to be incapable of using their foot as a sucker or as a fin, and die after a few writhings. The species in general prefer moist places, and seldom are very active in dry weather. After a shower they speedily leave their hiding-places, and at this time they may be readily collected. The eggs are hatched on land.

1. *Subdivision.*

Cloak and foot parallel, and containing the viscera between them.

In this group are included those animals denominated slugs in this country. They possess four retractile tentacula, of unequal length. The eyes are two in number, in the form of black points, seated at the tips of the posterior tentacula.

1. *Tribe.*

Cloak furnished with a shield.

The shield is, in general, strengthened internally by a deposition of earthy matter, in the form of grains, or a plate.

A. Shield anterior.

In this group, the shield is placed nearer the head than the tail. It contains four genera, two of which have compound tails, or furnished with peculiar organs, while in the remaining genera the tails are simple.

1. *Extremity of the Tail Compound.*

Genus, *Arion.*—A mucous orifice at the termination of the cloak.

This genus has been recently instituted by M. le Baron D'Audebard De Férrussac, in his *Histoire Naturelle Générale et Particulière du Mollusques Terrestres et Fluviatiles*, folio, Paris, 1819, 3e liv. p. 53. The species of which it consists were formerly confounded with those which now constitute the restricted genus Limax. It differs, however, in possessing the mucous pore, in the pulmonary orifice being near the anterior margin of the shield, with the sexual orifice underneath, and in the soft state of the calcareous matter in the shield. The author now quoted has described four species, and illustrated their characters by beautiful and expressive figures. The *Limax ater* (together with its variety *rufus*) of British writers may be regarded as the type of the genus.

Genus, *Plectrophorus.*—A conical protuberant shell at the termination of the cloak.

This genus, likewise instituted by M. Ferrussac, nearly resembles the preceding in form. Three species have been described and figured, which, however, differ remarkably from one another.

2. *Extremity of the Tail Simple.*

The genera of this group have neither a terminal mucous orifice nor shell.

Genus, *Limax.*—Pulmonary orifice near the posterior margin of the shield.

This genus, as now restricted by M. Ferrussac, differs from the Arion in the absence of the caudal mucous pore, the position of the pulmonary cavity, and the orifice of the sexual organs placed under the superior right tentaculum. The calcareous matter of the shield is more solid, and appears as a shelly plate. Six species have been described and figured. The *Limax cinereus* of Lister is the type of the genus.

Genus, *Limacellus.*—Pulmonary orifice near the anterior margin of the shield.

This genus was instituted by M. de Blainville, in the *Journal de Physique*, December 1817, p. 442, pl. 11, f. 5, nov. His observations were made on a specimen in a shrivelled state, preserved in spirits of wine, which was communicated to him from Dr Leach of the British Museum. Its history is, therefore, necessarily imperfect. The animal is rounded before and pointed behind, and dorsally protuberant. The whole body is smooth, soft, and of a greyish white colour. The shield, which adheres on all sides, is destitute of any shelly plate. It is notched near its anterior margin, at the opening of the pulmonary cavity. The foot is broad, and separated from the cloak by a slight fold, which, on the right side, forms a groove, leading from the base of the right tentaculum to the posterior extremity of the body. It is inferred from this appearance, that the sexual organs are disjoined, the female parts being seated in the tail, while the male organs occupy the ordinary position. The only species, *Limacellus lactescens*, is supposed to have been brought from the Antilles.

B. Shield posterior.

In this group, the shield is placed nearer to the tail than in the preceding, and is fortified internally with a subspiral plate. It contains one genus.

Genus, *Parmacella.*—Posterior extremity of the shield containing the shell.

The pulmonary cavity is placed underneath the shell of the shield. This arrangement occasions a corresponding posterior position to the heart. Along the back, from the shield to the head, are three grooves, the middle one of these is double. The shield itself adheres only at the posterior portion, the anterior part being free. The internal structure is similar to the slugs. The only marked difference, indeed, consists in two conical appendages of the sexual cavity, by which there is an approach to the *Helices*.

The *Parmacella Olivieri* is the only known species, and was first described, and its structure unfolded, by M. Cuvier. It was brought from Mesopotamia by M. Olivier.

2. *Tribe.*

Cloak destitute of a shield.

In this tribe, the pulmonary cavity is situate near the tail.

A. Tail covered with a single spiral open shell.

Genus, *Testacella.*—Pulmonary cavity underneath the shell.

The vent and pulmonary cavity are from the position of the protecting shell, on which they are dependent, nearly terminal. The foot extends on each side beyond the body. From the manner in which the blood is aerated, the auricle and ventricle are placed longitudinally, the latter being anterior.

This genus at present consists of three species. One of these, *T. haliotoideus*, is a native of France and Spain. It lives in the soil, and feeds on the earthworm. Another species, the *T. Maugei*, was first observed at Teneriffe by M. Mauge. It has been figured in the splendid work on the Mollusca, by Ferrussac, already referred to, Tab. vii. f. 10—12, from specimens found in the botanical garden of Bristol, and communicated by Dr Leach. It has been conjectured, that the British animals may have been introduced along with plants from Teneriffe. The third species, *T. ambiguus*, is established on the doubtful authority of a shell in the collection of M. Lamarck.

B. Destitute of an external shell.

Genus, *Veronicellus.*—Cloak fortified posteriorly by an internal shelly plate. Tentacula four.

This genus was instituted by M. Blainville for the reception of the *V. lævis*, established from a specimen preserved in spirits, belonging to the British Museum, and communicated by Dr Leach. It is figured

by Ferrussac, Tab. vii. Fig. 6, 7. The body is somewhat pointed before, and rounded behind. The cloak is large; the foot rather narrow, and plaited on the edges. The opening to the pulmonary cavity is situate on the right side posteriorly, under the shell. A little in advance of this is another opening, in the middle of which is the funnel-shaped aperture of the anus. The sexual organs are united, and placed at the base of the right tentaculum.

It is not improbable, according to Ferrussac, that the *Limax nudus cinereus terrestris* of Sloane (*Jam.* ii. p. 190, Tab. ccxxxiii, f. 2, 3), may belong to this genus, or rather, that the individual brought home by Sloane may have been the identical specimen submitted to M. Blainville's examination.

Genus, *Onchidium*.—Cloak tuberculated. Snout enlarged and emarginate. Tentacula two in number, with eyes at the tips.

This genus was instituted by Dr Buchanan, in *Lin. Trans.* Vol. V. p. 132, for the reception of a species which he found in Bengal, on the leaves of *Typha Elephantina*. It is not, according to this naturalist, "like many others of the worm kind, an hermaphrodite animal; for the male and female organs of generation are in distinct individuals. I have not yet perceived any mark to distinguish the sexes, while they are not in copulation, as in both, the anus and sexual organs are placed in a perforation (cloaca communis), in the under part of the tail, immediately behind the foot; but during coition, the distinction of sexes is very evident, the penis protruding to a great length, considering the size of the animal."

2. *Subdivision.*

Cloak and foot parallel; the viscera contained in a spiral dorsal protuberance, protected by a shell.

This group includes the animals usually denominated Snails. They bear a very close resemblance to the slugs. The shield, however, has a thickened margin in front, destined to secrete the matter of the shell. In the part corresponding with the centre of the shield in the slugs there is (as Cuvier has characteristically termed it) a *natural rupture*, through which the viscera are protruded into a conical bag twisted spirally. In this bag are contained the principal viscera, the liver occupying its extremity. The body of the animal is attached to the pillar of the shell by a complicated muscle, which shifts its place with the growth of the animal. The mouth is furnished above with a thin-arched corneous mandible, notched on the edges. The whole body, including the foot and head, are, in general, capable of being withdrawn into the cavity of the shell. In one genus, the aperture is closed by a lid.

1. *Tribe.*

The foot is furnished with a lid or operculum, for closing the mouth of the shell when the animal withdraws itself into the cavity.

Genus, *Cyclostoma*.—Aperture of the shell circular.

The tentacula are linear and subretractile. The primary ones have subglobular, highly-polished extremities, considered by Montague as the eyes. The true eyes, however, are placed at the exterior base of the large tentacula, and are elevated on tubercles, which are the rudiments of the second pair.

The aperture of the pulmonary cavity is situate on the neck. The sexes are likewise separate; the penis of the male being large, flat, and muscular. The mouth is formed into a kind of proboscis, and the upper lip is deeply emarginate. The *Turbo elegans* of British conchologists is the type of the genus.

2. *Tribe.*

Foot destitute of a lid.

A. Aperture of the shell with a thickened margin.

In all this division, the margin of the shell, while the animal is young, is thin; but upon reaching a certain period, it becomes thick, and bordered with a ring, after which, there is no increase of size.

1. *Last formed Whorl of the Shell greatly larger than the penultimate one.*

Genus, *Helix*.—Snail. Aperture of the shell lunulated; the width and length nearly equal.

The snails differ from the slugs chiefly in the organs of reproduction. The vagina, previous to its termination in the sexual cavity, is joined by the canal of the vesicle, and by two ducts, each proceeding from a bundle of multifid vesicles. Each bundle consists of a stem or duct, and numerous branches, with blunt terminations. These organs secrete a thin milky fluid, the use of which is unknown.

The species belonging to this genus are numerous, and exhibit, in the form, the markings, and the coverings of the shell, numerous characters for their subdivision.

Genus, *Bulimus*.—Aperture of the shell longer than broad.

The structure of the animals of this genus has not been determined; but analogy would lead us to conclude, that it is similar to the snails. While the shells of the Helix are globose, those of Bulimus are turrited.

2. *Last Whorl nearly of the same size as the penultimate one, or even less.*

The genera of this group are already noticed sufficiently in detail, in the article Conchology of this *Supplement*, under the 27 genus, *Turbo*.

B. Aperture of the shell destitute of thickened margin.

There is in this group no certain indication of maturity or stationary growth.

1. *Mouth of the Shell at the Pillar entire.*

Genus, *Vitrina*.—Margin of the shield double.

The upper fold of the shield is divided into several lobes, which are capable of being reflected over the surface of the shell. The shell itself is not capable of containing the whole body of the animal. The *Helix pellucida* of Muller is the type of the genus. It is a common British species, and was hastily regarded by Montague as the fry of the Helix lucida.

2. *Mouth of the Shell at the Pillar effuse.*

Genus, *Succinea.*—Termination of the pillar rounded.

The *Helix putris* of British writers is the type of the genus.

Genus, *Achatina.*—The termination of the pillar truncated.

The *Buccinum acicula* of Muller, a native of England, belongs to this genus; and likewise the *Helix octona* of Linnæus, erroneously considered as a native of Britain.

II. Order.

AQUATIC.

The aquatic pulmoniferous gasteropoda have their residence constantly in the water. They possess two tentacula only. These are usually flattened, incapable of being withdrawn, and having eyes at the internal base. The food consists of aquatic plants. Respiration can only take place at the surface of the water, to which the animals occasionally ascend, to expel from the pulmonary cavity the vitiated air, and replenish it with a fresh supply. The sexes are united. The spawn, which is in the form of a rounded gelatinous mass, containing many ova, is deposited on aquatic plants under water. Previous to hatching, the fœtus must be aërated by means of some branchial arrangement.

1. *Subdivision.*

Body protected externally by a shell.

The animals belonging to this subdivision bear a very close resemblance to the snails, in the structure of their body, and the form of their shell.

1. *Tribe.*

The protecting shell spirally twisted.

A. Shell turrited.

1. *Whorls dextral.*

Genus, *Lymneus.*—Aperture of the shell having the right lip joined to the left at the base, and folding back on the pillar.

The tentacula are lanceolate and depressed. The mouth is furnished with three jaws; the lateral ones simple; the upper one crescent-shape, and emarginate. The male and female organs, though intimately connected, internally, have their external orifices separated to a considerable distance, the former issuing under the right tentaculum, the latter at the pulmonary cavity. There are several species natives of Britain.

2. *Whorls sinistral.*

Genus, *Physa.*—Pillar-lip destitute of a fold.

The external appearance of the animal is similar to the Lymneus; but the margin of the cloak is loose, divided into lobes, and capable of being reflected over the surface of the shell near the mouth. This genus was instituted by Draparnaud. The *Bulla fontinalis* of British authors is regarded as the type of the genus.

Genus, *Aplexa.*—Pillar-lip, with a fold.

This genus was instituted by us for the reception of the *Bulla hypnorum* and *rivalis* of British writers. The shell is more produced than in the physa. The cloak of the animal is incapable of being reflected on the shell, and its margin is destitute of lobes.

B. Shells depressed.

The spires revolve in nearly the same horizontal line. The tentacula are long, and filiform.

Genus, *Planorbis.*—Cavity of the shell entire.

This is another sinistral genus; the vent, pulmonary cavity, and sexual organs, being on the left, and the heart on the right side. The *P. corneus,* the type of the genus, pours forth, when irritated, a purple fluid from the sides, between the foot and the margin of the cloak.

Genus, *Segmentina.*—Cavity of the shell divided.

Externally, the shell appears similar to planorbis; but internally, it is divided by testaceous transverse partitions into several chambers, which communicate with each other by triradiated apertures. It is uncertain whether the animal is to be considered as dextral or sinistral. This genus was instituted by us several years ago, for the reception of the *Nautilus lacustris* of Lightfoot, first described and figured in *Phil. Trans.* Vol. LXXVI. p. 160. Tab. i. f. 1. 8.

2. *Tribe.*

Shell simply conical.

Genus, *Ancylus.*—Foot short, elliptical.

The tentacula are short, compressed, and a little truncated. This genus was formed by Geoffroy, and includes the *Patella lacustris* and *oblonga* of British conchologists.

2. *Subdivision.*

Body destitute of the external protection of a shell.

Genus, *Peronia.*—Head with two long retractile tentacula. The snout is divided into two broad appendages. Between the tentacula, towards the right side, is the opening for the penis. The anus is terminal, immediately above which is the entrance to the pulmonary cavity; and on the right is the opening to the female organs, from which a groove runs towards the right lobe of the snout.

This genus, which we have named in honour of M. Peron, was referred by Cuvier to the Onchidium of Buchanan, which we have already noticed, and the species termed *O. Peronii.* It was found creeping upon marine rocks, under water, at the Mauritius, by M. Peron. M. Cuvier conjectures that it breathes free air, and has accordingly inserted it among the *Pulmones aquatique.* Some doubts, however, may reasonably be entertained about the truth of this supposition. It would certainly be an unexpected occurrence to find a marine gasteropodous mollusca obliged to come to the surface at intervals to respire. It will probably be found that it is truly branchiferous.

II. Class.

BRANCHIFERA.

The molluscous animals of this class are more numerous than those of the preceding. They chiefly

inhabit the waters of the ocean, a few genera only being met with in fresh water lakes and rivers. The branchiæ which constitute their aërating organs exhibit numerous varieties of form, position, and protection, and furnish valuable characters for their methodical distribution.

I. Order.

Branchiæ external.

The branchiæ are pedunculated, and more or less plumose. They are moveable at the will of the animal, and in general are capable of great alteration of form.

1. *Tribe.*

Branchiæ exposed.

In nearly all the genera the branchiæ are numerous, and distributed regularly over the cloaks or sides.

A. Branchiæ issuing from the cloak dorsally.

1. *Body exposed, and destitute of a shell.*

In many species the back is covered with perforated papillæ, which pour out a mucous secretion. All the species are hermaphrodite, with reciprocal impregnation.

a. Anus situate near the posterior extremity of the back, and surrounded with a fringe of plumose branchiæ.

Genus, *Doris.*—Oral tentacula two; vent without scales.

The cloak is covered with retractile papillæ, and separated from the foot by a distinct duplicature. Towards its anterior margin are placed the two superior tentacula. These are retractile, surrounded at the base with a short sheath, and supported on a slender stem, having an enlarged compound plicated summit. The neck is short, and above the mouth there is a small projecting membrane, connected at each side with the oral tentacula, which are in general minute, and of difficult detection.

The following species are natives of the British seas: 1. *D. Argo*; 2. *verrucosa*; 3. *lævis*; 4. *marginata*; 5. *nodosa*; 6. *quadricornis*; 7. *nigricans.*

Genus, *Polycera.*—Oral tentacula more than two.

The branchiæ, when withdrawn, are protected by two scales. The superior tentacula resemble those of the Doris, the oral ones are more numerous, sometimes amounting to six. *P. flava* and *pennigera* are British examples.

b. Anus situate on the right side, and unconnected with the branchiæ.

(A.) Mouth furnished with corneous jaws.

These jaws are in the form of narrow plates, which cut the food by crossing each other like the blades of a pair of scissars.

(1.) Branchiæ disposed along the back or sides, and unconnected with membranaceous expansions.

(a.) Tentacula limited to two in number.

Genus, *Tergipes.*—Branchiæ furnished with sheaths at the base.

The branchiæ form a single row on each side, and are qualified to act as suckers. The *Limax tergipes* of Forskael, *Des. An.* p. 99, is the type of the genus. *T. maculata*, described by Montagu, *Lin. Trans.* VII. p. 80, T. vii. f. 8, 9, is a British example.

Genus, *Tritonia.*—Branchiæ destitute of basilar sheaths.

The branchiæ are in the form of plumes, or imbricated productions, placed in a row on each side the back. The tentacula, which are partially retractile, have a sheath at the base. In some of the species there are indications of eyes. The *T. arborescens*, *pinnatifida*, and *bifida*, are examples of British species.

(b.) Tentacula four in number.

The branchiæ are simple, tapering, or clavate, and disposed in transverse rows on each side. These branchiæ in some species readily fall off, and are capable of swimming about in the water for a short time, as if independent. This is executed by means of minute hairs with which their surface is covered, and which move rapidly, pushing forward the distal extremity.

Genus, *Montagua.*—Branchiæ in continuous rows across the back.

This genus, which differs from the other not merely in the arrangement of the branchiæ, but in possessing a cluster of short papillæ on the right side, probably connected with the anus, we have ventured to name in honour of the late George Montagu, the well-known author of *Testacea Britannica*, and of several valuable papers in the *Linnean Transactions*, on molluscous animals. The two species which may be referred to this genus were detected in Devonshire by this observer. The first, *M. longicornis, Lin. Trans.* Vol. IX. p. 107. Tab. vii. f. 1, is the type of the genus. The other species, *M. cærulea*, *Lin. Trans.* Vol. VII. p. 78. Tab. vii. f. 4, 5, is probably the type of another genus.

Genus, *Eolida.*—Branchiæ interrupted on the back.

This genus, which was instituted by M. Cuvier, includes the following British examples: 1. *E. papillosa*; 2. *plumosa*; 3. *pedata*; 4. *purpurascens.*

(2.) Branchiæ disposed on lateral membranaceous expansions.

These expansions serve the double purpose of supporting the branchiæ, and acting as fins.

Genus, *Scyllea.*—Branchiæ seated dorsally on the fins. Tentacula two.

On each side of the back are two membranaceous expansions, and one on the tail, supporting on their dorsal surface scattered plumose branchiæ. The tentacula are each furnished with a large funnel-shaped sheath. The foot is very narrow, with a mesial groove, used in climbing up the stalks of sea weeds. The mouth is placed at the base of the tentacula, and surrounded with a semicircular lip. The tongue is in the form of a tubercle, with reflected points. The gullet is plaited longitudinally. The stomach is short and cylindrical, with a ring of hard longitudinal scales. The liver consists of six unequal globules, and the bile is poured into the cardiac extremity of the gullet. The *Scyllea pelagica* has been long known to naturalists, and appears to

be very common in the equatorial seas, adhering to the stems of the *Fucus natans*.

Genus, *Glaucus*.—Branchiæ seated on the margin of the fins. Four simple tentacula.

On each side of the body there are three or four membranaceous expansions, the margins of which are fringed with the simple branchial filaments. This genus was instituted by R. Forster, and the oldest known species, *G. radiatus*, is figured, *Phil. Trans.* Vol. LIII. Tab. iii.

(B.) Mouth destitute of corneous jaws.

Genus, *Thethys*.—Branchiæ forming a row on each side the back, consisting of fringed processes, alternately larger and smaller.

The *T. fimbria* is the type of the genus, a figure of which, with its anatomical details, is given by M. Cuvier, in his *Mémoire sur le Genre Thethys*.

2. Body concealed in a Spiral Shell.

This section includes the genus Valvata of Muller, represented by two British species, *V. cristata* (*Helix cristata* of Montagu) and *V. piscinalis* (*Turbo fontinalis*). These resemble in aspect the aquatic pulmoniferous gasteropoda. The branchiæ appear in the form of a feather, with a central stem, and a row of compound branches on each side, decreasing in size from the base to the free extremity. It issues from the neck near the middle, a short way behind the anterior tentacula. Near this plume, but towards the right side, is a single simple filament, like a tentaculum. The anterior tentacula occupy the usual position, are setaceous, and have the eyes placed at the base behind. The spiral shell is capable of containing the body, and the aperture can be closed by a spirally striated operculum attached to the foot. The internal structure is unknown.

B. Branchiæ issuing laterally from between the cloak and foot.

This division includes the orders *Cyclo-branchia* and *Infero-branchia* of Cuvier, which we have ventured to bring together, as connected by the common character of the position of the gills.

1. Body protected dorsally by a shelly covering. Cyclobranchia.

a. Shell simple.

Genus, *Patella*.—Shell entire. Mouth with tentacula.

The species belonging to this genus are numerous, and appear to admit of distribution into sections; the first having the branchial circle complete, the second interrupted.

b. Shell divided.

Genus, *Chiton*.—Shell constituting a series of imbricated dorsal plates.

The body is elliptical. Th cloak is firm and cartilaginous, and variously marked on the margin. The dorsal plates are arched, and occupy the middle and sides of the back, where they are implanted in the cloak, in an imbricated manner, the posterior margin of the first valve covering the anterior of the second. The foot is narrow. The mouth is surrounded with a semicircular curled membrane, and is destitute of tentacula. The anus consists of a short tube, placed at the posterior extremity of the cloak. The external orifice of generation has not been detected.

Genus, *Chitonellus*.—Dorsal plates not imbricated.

In this genus, instituted by Lamarck (*Hist. Nat. des Animaux sans Vertebres*, Vol. VI. p. 316), the shells are slender, narrow, and are disposed longitudinally, and not in contact, along the middle of the back, leaving the sides of the cloak naked. Two species, *C. lævis* and *striatus*, were brought from New Holland, by Peron and Le Sueur.

2. Body naked. Inferobranchia.

Genus, *Phyllidia*.—Anus placed dorsally near the extremity of the cloak.

M. Cuvier has given descriptions of three from the tropical seas, which differ remarkably in the protuberances of the cloak.

Genus, *Diphyllidia*.—Anus placed on the right side.

This genus was formed by M. Cuvier in his *Regne Animal*, Vol. III. p. 395, from an imperfectly investigated animal, in the cabinet of M. Brugmans at Leyden. The cloak is pointed behind, with a feeler and small tubercle on each side.

2. Tribe.

Branchiæ simple, and concealed when at rest under a lid. *Tectibranchia* of Cuvier.

A. Head furnished with tentacula.

1. Tentacula four in number.

a. Branchiæ lateral.

Genus, *Aplysia*.—Branchiæ with a corneous lid.

The *A. depilans*, the type of the genus, is of frequent occurrence on the British shores. The *A punctata* of Cuvier may be regarded merely as a variety.

It is probably at this place where the genus Gasteroplax of Blainville, published by Lamarck, under the ill-judged title Umbrella (*Hist. Nat.* &c. Vol. VI. p. 339), should be introduced. The following is the extended characte which he has communicated.

"Corpus valde crassum, obovatum, testa dorsali onustum; pede amplissimo, subtus plano, undique prominente, anterius sinu emarginato, postice attenuato. Caput non distinctum. Cavitas infundibuliformis in sinu antico pedis os in fundo recondens. Tentacula quatuor: superiora duo, crassa, brevia, truncata, hinc fissa, intus transversim sublamellosa; altera duo, tenuia, cristata, pedicellata, ad oris latera. Branchiæ foliaceæ, serratim ordinatæ, infra cutis marginem per totam longitudinem lateris dextri. Anus post extremitatem posticam branchiarum.

"Testa externa, orbicularis, subirregularis, planulata, superne convexiuscula, albida, versus medium mucrone apicicali brevissimo præbita; marginibus acutis: interna facie subconcava; disco calloso, colorato, ad centrum impresso, limbo lævi cincto."

Doubts seem to be entertained whether the shell is to be considered as belonging to the cloak or the foot. Two species are known.

Genus, *Notarchus*.—Lid of the branchiæ soft.
There is an oblique groove from the neck leading to the branchiæ. The structure is similar to Aplysia. M. Cuvier instituted this genus in his *Regne An*. Vol. II. p. 395, and Vol. IV. Tab. xi. f. 1.

b. Branchiæ terminal.

Genus, *Dolabella*.—Dorsal plate a solid shell.

2. *Tentacula two in number.*

Genus, *Pleurobranchus*.—Cloak and foot expanded, between which, on the middle of the right side, the branchiæ are placed.

B. Head destitute of tentacula.

Genus, *Bulla*.—Body of the animal protected by a convoluted shell.

M. Lamarck is inclined to divide this genus into two, distinguishing those in which the shell is concealed, by the term *Bullæa*, from such as have the shell in part exposed, which he retains in the genus *Bulla*. The shells of the genus Bullæa are thin and white, as *B. aperta;* those of Bulla stronger, more opaque, and covered with an epidermis, which, after the death of the animal, is easily detached, as *B. lignaria*.

Genus, *Doridium* (of Mekel).—Destitute of a dorsal plate or shell.

There is a cavity in the cloak, with a spiral turn. The branchiæ, and accompanying organs, are placed far behind. There is here no appearance of a spinous tongue; the gullet is simple, and the stomach is membranaceous. *D. carnosum*, a native of the Mediterranean, is the type of the genus.

II. Order.

Branchiæ Internal.

These aërating organs are contained in a cavity, and appear in the form of sessile pectinated ridges.

1. *Subdivision.*

Heart entire, and detached from the rectum.

This group, forming the *Pectinobranchia* of Cuvier, includes nearly all the marine gasteropoda which have spiral univalve shells. It likewise contains a few species which inhabit the fresh water.

1. *Tribe.*

Shell external.

The shelly covering exhibits all the variations of the spiral form. The internal structure has hitherto been in a great measure neglected, so that the characters, employed in the methodical distribution of the species and genera, are derived from the shelly appendage of the cloak. The groups, therefore, are merely artificial temporary combinations.

A. Aperture of the shell entire.

As co-existent with this character of the shell, the anterior margin of the cloak, at the entrance to the branchial cavity, is found likewise to be entire.

1. *Aperture of the shell closed by a pedal lid, or operculum.*

The three following families appear to be the indications of as many natural groups, the genera of which admit of still more minute arrangement.

1. Family, *Turbonidæ*.—Aperture of the shell round or ovate.

This family includes the greater number of the species of the Linnean genus Turbo. The genera into which it is now divided may be distributed into two sections, from the residence of the animals.

1. Section, *Marine*.

The marine turbonidæ are of frequent occurrence, and compose the genera Turbo, Delphinula, Turritella, Scalaria, Odostomia, Monodonta, Phasianella, and Vermicularia. Some of the species are known to be ovoviviparous, and it is probable that the same kind of reproduction prevails in all of them. Remarkable differences may be observed in the form of the hood, the length of the peduncles supporting the eyes, and the number and distribution of the filaments surrounding the body.

2. Section, *Fluviatile*.

The fluviatile turbonidæ are limited in their number both in regard to genera and species. The genera are only three, Ampullaria, Melania, and Paludina. In the last of these, including the *Helix vivipara* and *tentaculata*, the sexes are distinct in different individuals.

2. Family, *Neritadæ*.—Aperture semicircular, with an oblique straight pillar-lip.

1. Section, *Marine*.

This includes the genera Nerita and Natica.

2. Section, *Fluviatile*.

This contains only the genus Neritina, including *Nerita fluviatilis* of Linnæus.

3. Family, *Trochusidæ*.—Aperture of the shell subquadrangular.

All the genera, including Trochus, Solarium, and Pyramidella, are marine. The cloak on each side is usually ornamented with three filaments.

2. *Aperture of the shell exposed.*—The foot destitute of a lid. Marine.

Genus, *Janthina*.—Foot with an adhering spongy body.

In this genus, represented by the *Helix Janthina* of Linnæus, the spongy body is capable of changing its dimensions, and enabling the animal to sink or rise in the water at pleasure. When irritated, it ejects a purple fluid from the cellular margin of the cloak above the gills, not unlike the Aplysia.

Genus, *Velutina*.—Foot simple.

This genus was formed by us for the reception of the *Bulla velutina* of Muller (*Zool. Dan*. Tab. ci. f. 1, 2, 3, 4), the *Helix lævigata* of British writers.

B. Anterior margin of the aperture of the shell canaliculated.

This groove in the aperture of the shell is produced by the anterior margin of the cloak being extended over the opening into the gills, for the purpose of acting like a tube or syphon, in conveying the water to and from the branchial cavity. The species are considered as oviparous, with distinct sexes in separate individuals.

1. *Shell convoluted.*—The shell has a lengthened

mouth parallel with its length. The whorls, which are small segments of large circles, are wrapped round the pillar, and rising little the one above the other, embrace or enclose the preceding ones. The four following families appear to belong to this division.

1. Family, *Conusidæ.*—Furnished with a long proboscis, and produced tentacula, with the eyes near the summit on the outside. The genera Conus and Terebellum form this family.

2. Family, *Cypreadæ.*—Cloak enlarged, and capable of folding over the shell. There is no lid. The genus Cyprea is the type.

3. Family, *Ovuladæ.*—Both extremities of the aperture canaliculated. The inhabitants of all the genera, Ovula, Calpurna, and Volva, are unknown. The last genus includes the *Bulla patula* of Pennant.

4. Family, *Volutadæ.*—Canal of the aperture abbreviated. Pillar-lip plaited. The foot appears to be destitute of a lid. The genera are numerous. Voluta, Oliva, Cymbium, Marginella, Cancellaria, Mitra, Ancilla, Volvaria, and Tornatella. The last genus contains the *Voluta tornatilis* of British writers.

2. *Shell turrited.*—The whorls of the shell, the revolving spire of which is subconical, scarcely embrace one another, but are merely united at the margins. Three families may here be established.

1. Family, *Buccinidæ.*—Canal short, scarcely produced beyond the anterior margin of the lip, and bent towards the right. The tentacula are remote, and the head is destitute of a hood. The mouth has a retractile proboscis. The following genera belong to this family: Buccinum, Eburna, Dolium, Harpa, Nassa, Purpura, Cassis, Morio, and Terebra.

2. Family, *Muricedæ.*—Canal produced, and straight. The tentacula approach. The head and mouth as in the preceding family. The genera are, Murex, Typhis, Ranella, Fusus, Pleurotoma, Pyrula, Fasciolaria, and Turbinella.

3. Family, *Cerithiadæ.*—Canal short and recurved. Head with a hood. This family contains the marine genus Cerithium, and the fluviatile one Potamidum.

4. Family, *Strombusidæ.*—Canal short, and bent towards the right. The outer margin of the aperture becomes palmated with age, and exhibits a second canal, generally near the former, for the passage of the head. The following are the genera: Strombus, Pterocera, and Rostellaria.

2. *Tribe.*

Shell internal.

This tribe consists at present of only one genus, termed Sigaretus, two species of which are natives of Britain.

2. *Subdivision.*

Heart traversed by the rectum.

This group includes the order Scutibranchia of Cuvier. In general form, and in structure and position of the branchiæ, the resemblance is very close to the genera of the preceding subdivision. They differ, however, in many particulars. The heart is furnished with two auricles, and is perforated by the intestine. The sexes appear to be incorporated in the same individual, or rather the male organs are unknown. The body is protected by a shell, the aperture of which is wide, and never closed by a lid.

1. *Tribe.*

Shell ear-shaped, flat, with a lateral, and nearly concealed spire.

Family, *Haliotidæ*, including the genera Haliotis, Padola, and Stomatia. These genera exhibit well-marked characters in the shell. The left margin of the shell in Haliotis is pierced by a row of holes. In Padola, these holes are nearly obliterated; but there is an internal groove and external ridge in the line of their direction. In Stomatia, there are neither holes nor ridges.

2. *Tribe.*

Shell conical, simple, or slightly revolute at the apex.

A. Cavity of the shell interrupted by a testaceous plate. This division consists of three genera, each of which may be regarded as the type of a family, although, for the present, they all be included in one.

Family, *Crepiduladæ.*—The *marine* genera are, Crepidula and Calyptrea, the latter including the *Patella Chinensis* of British writers. There is only one fluviatile genus, termed Navicella.

B. Cavity of the shell entire.

1. Family, *Capuluside.*—Shell entire.

This includes the genera Capulus (containing *Patella Hungarica* and *antiquata* of British writers) and Carinaria, represented by the *Argonauta vitria.*

2. Family, *Fissurelladæ.*—Shell with a slit, or perforation.

In the Fissurella, the apex of the shell is perforated. In Emarginula, there is a slit in the anterior

II. Division.

MOLLUSCA ACEPHALA.

Destitute of a distinct head or neck.

The animals of this division are much more simple in their organization than those of the preceding division. In none of the species are there any rudiments of organs of hearing or of sight. They are destitute of jaws or other hard parts about the mouth. They all inhabit the water, and possess branchiæ. The organs of the two sexes are incorporated in the same individual, and reciprocal union is unnecessary. They are either oviparous or ovoviviparous. The presence or absence of a shelly covering furnish characters for a twofold distribution of the groups.

I. Section.

Acephala Conchifera.

The shell, which in all cases is external, is bivalve, and exhibits very remarkable differences in the form

 relative size, and connection of the valves. The cloak is likewise in the form of two leaves, corresponding with the valves which protect it.

1. Order.

Brachiopoda.

Mouth with a spiral arm on each side fringed with filaments.

The genera included in this group constitute the Brachiopoda of Cuvier. The lobes of the cloak are free anteriorly. From the body, between the lobes, the arms have their origin, at the margin of the mouth. These arms are capable of folding up spirally. All the species are permanently attached to foreign bodies, and inhabit the sea. Their nervous and reproductive systems have received but little elucidation.

1. *Subdivision.*

Shell supported on a fleshy peduncle.

Genus, *Lingula.*—Valves equal, the apex of both attached to the peduncle.

The peduncle is nearly cylindrical, cartilaginous, and covered with a membrane consisting of circular fibres. The valves are oval, flat, and destitute of teeth, or elastic ligaments. The adductor muscles are numerous, obliquely placed, and appear capable of giving to the valves a considerable degree of lateral motion. The cloak is thin, and has interspersed muscular fibres. Its margin is thickened, and fringed with fine hairs of nearly equal length.

The *Lingula unguis* is the only known species, the structure of which has been developed by Cuvier.

Genus, *Terebratula.*—Valves unequal, the peduncle passing through an aperture in the largest valve.

The arms are shorter than those of the Lingula, and are said to be forked. They are supported within by numerous arcuated plates.

M. Lamarck divides the recent kinds into two sections. 1. *Shell smooth, or destitute of longitudinal ribs.* The *T. cranium*, a native of the Zetland seas, may be quoted as an example. The peduncle is simple. 2. Shell ribbed longitudinally. The *T. aurita*, which inhabits Loch Broom, is another, though recently discovered, British example. The larger valve is broadest in the middle, semicircular in front, and narrowing towards the apex, in consequence of the sides being compressed or bent inwards. The ribs from the beak towards the anterior margin are the most distinct, rounded, and about eight in number; those towards the sides are obsolete. The under valve is nearly orbicular, with the margin at the hinge truncated, or rather obtusely angular, and having the sides depressed, and forming small auricles, as in the genus Pecten, but not produced. The ribs are obsoletely wrinkled across, and the margin is waved by the ribs being concave internally. The inner surface of both valves, especially the largest, is finely punctulated. The hinge is formed by a projection on each side, the proximal margin of the perforation in the large valve entering corresponding depressions in the smaller one. The margin of the perforation itself is completed by the application of the smaller valve. The peduncle is short, and consists of numerous unequal-sized tubular threads, attached by a complicated tendino-muscular apparatus, chiefly to the larger valve. The spiral arms seemed to have simple summits, and to be destitute of testaceous plates. The smallness and probable youth of the subject, however, rendered minute examination of the structure impracticable. Trawled up in Loch Broom, near the harbour of Stornoway, 16th August 1821. This species approaches nearest to the *T. truncata.*

The fossil species of this genus are numerous, and occur in the older and newer of the floetz formations. They furnish obvious characters for the construction of many genera, some of which have been already established.

2. *Subdivision.*

Shell sessile.

Genus, *Criopus.*—Under valve cemented to stones.

The under valve is membranaceous, flat, and adhering; the upper is flatly conical, and resembles a patella, in which genus, from neglecting the structure of the animal, it has usually been placed.

The *C. anomalus*, *Patella anomala* of Muller, *Zool. Dan.* Tab. v. f. 1, 8, has a branched double ovarium, with round eggs. It has been described and figured as a native of the Zetland seas, under the term *Patella distorta*, in *Edin. Encyclopædia*, Vol. VII. p. 65, Tab. cciv. f. 4; and *Lin. Trans.* Vol. XI. p. 195, Tab. xiii. f. 5.

II. Order.

Bivalvia.

Mouth destitute of fringed spiral arms.

The animals of this group form the class Conchifera of Lamarck, the Bivalvia of the older naturalists.

The shells exhibit great variety of form and relative size. They are joined together at the hinge, which is either plain or toothed, and corresponds in position with the back of the animal. The connection of the two valves is secured by the intervention of an elastic horny *ligament*, the office of which is to keep the valves open. It is either external or internal. The valves are closed by means of *adductor muscles*, intermixed with tendons, and, passing transversely through the animal, adhere to the corresponding places in the inside of each shell. By the contractions of these muscles the free edges of the valves are brought into contact, at the same time that the ligament is compressed or stretched, according as it is internal or external. The number of muscular impressions is employed by Lamarck in the division of the Bivalvia into two orders, *Dimyaires* and *Monomyaires.* This distinction, however, he has not attended to with care, as in his family *Mytilacées*, which he includes in his second order, or those having one adductor muscle, there are obviously two adductor muscles, although the one is certainly much larger and more complicated than the other. Besides these impressions of the adductor muscles, there are others connected with the foot and byssus. The cloak lines the inside of the shells. In some cases it is entirely open, when the border corresponding with the free margin of the shell is thickened, and more or less fringed with contractile irritable filaments. In other cases the cloak in front is more or less united, and

even forms tubular elongations, which are termed *syphons*.

Locomotion is denied to many species of this order. Among these some are immoveably cemented to rocks and stones, as oysters; a few are attached by a cartilaginous ligament, as the Anomiæ; while others are fixed by means of a *byssus*. This last organ consists of numerous filaments issuing from a complicated apparatus in the breast, connected with a secreting gland and with the shell by the intervention of tendinous bands. The *foot* is seated a little towards the mouth, is usually tongue-shaped, capable of considerable elongation, with a furrow on its posterior surface. This organ, where a byssus is present, is considered as employed in opening and fixing the threads. When there is no byssus, it either acts as a sucker, enabling the animal to crawl among the surface of bodies, or as a paw, to dig holes in the sand or mud. None of the species can float in the water. They either crawl or leap, the last kind of motion being effected by suddenly opening and shutting the valves. In securing a residence, some of the species *bore* into different substances by means of a rotatory motion of the shell. It was at one time supposed that the dwelling was formed by a secretion affecting the solution of the surrounding substance. But the very different substances penetrated by the same species, as limestone, slate-clay, and wood, forbid us to entertain such a supposition.

The nervous system is here but little developed. The superior and inferior ganglia, surrounding the gullet, give rise to all the nervous filaments which proceed through the body.

The digestive organs are scarcely less simple. The food is soft and swallowed entire, and either brought to the mouth by accident, or by eddies produced in the water, by the opening and shutting of the shells, aided in some cases by the syphons.

It may be proper here to state, in order to understand the relative situation of the parts, that, upon laying the animal upon its back, and opening the cloak, the abdomen appears to occupy the middle longitudinally, and the branchia to be arranged on each side. The mouth is situated at the anterior extremity, and consists of a simple aperture entering into the gullet, or rather stomach. It is surrounded by four flattened moveable tentacula, two of which in some are in part united with the cloak, while in others they are free to the base. In their structure they resemble the branchiæ. The stomach is full of cells, the bottom of each pierced with a biliary duct. A singular organ, termed the *crystalline process*, cylindrical, cartilaginous, and transparent, is found in some species projecting into the cavity of the stomach. The liver is large, surrounds the stomach, and pours out its contents by numerous openings. The intestine terminates posteriorly by a tubular anus.

The branchiæ consist of two ribbands on each side, extending the length of the body, free on the sides and margin, and striated transversely. These plates are frequently of unequal size. The blood is brought to these by means of pulmonic veins, without the intervention of the heart. The aërated blood is transmitted to a systemic heart, consisting of one or two auricles, and a ventricle.

The reproductive organs of the Bivalvia, hitherto examined, consist of an ovarium occupying the sides of the body, and penetrating the membranes of the cloak. They appear to have the organs of both sexes incorporated, and to propagate without intercourse. Lamarck is disposed to consider impregnation produced by the male fluid dispersed through the water; a supposition unsupported even by analogy in the animal kingdom. Many species are ovoviviparous; in which case the eggs when ripe pass into the gills, where they are hatched.

The methodical distribution of the Bivalvia appears to be attended with peculiar difficulties, in consequence of the uniformity which prevails in the structure and disposition of their organs. The characters furnished by the shell, though useful in the construction of generic as well as specific distinctions, have been abandoned by those who prefer a knowledge of the structure, rather than the form of an animal. The characters derived from the presence of a byssus, a foot, or syphons, appear to be nearly of co-ordinate importance. M. Cuvier gives the preference to those founded on the appearances of the latter, and distributes the genera into five families, an arrangement which we here propose to follow. These, however, may be considered as occupying a much higher rank, and each as including numerous families.

1. *Subdivision.*

Cloak open.

There are no syphons, the anterior margin of the cloak being as open as the mouth of the shell. When the valves open, the water comes immediately in contact with the branchiæ and mouth. The margin of the mantle has a double fringe of filaments.

1. *Tribe.*

Valves closed by one adductor muscle.

A. *Pectenidæ.* Animals free or fixed only by a byssus. Furnished with a foot.

Into this family, contemplated by Lamarck, the following ill assorted genera may be placed: Pecten, Lima, Pedum, Plicatula, Vulsella, Placuna, Gryphæa, Perna, and Crenatula.

B. *Ostreadæ.* Shell cemented to foreign bodies. Body destitute of a foot.

To this family the following genera are related: Ostrea, Spondylus, and Anomia. The last genus ought to form a family apart.

2. *Tribe.*

Shell closed by two adductor muscles.

The two genera, Avicula and Meleagrina (of Lamarck), form one family of this tribe; the genus Pinna another; and the Arcadæ a third, including Arca, Pectunculus, Nucula, Cucullæa, Trigonia, and Castalia.

2. *Subdivision.*

Cloak more or less closed, forming syphons.

The further division of this group depends on the modifications of the syphons, or aperture of the cloak.

1. *Tribe.*

The union of the cloak forming only one syphon. This is situate posteriorly opposite the anus, and serves for the purpose of the excrements. The other

large opening allows the water to enter to the mouth and gills.

This tribe may be divided into two families. The first, *Mytilusidæ*, will include the genera Mytilus, Modiolus, and Lithodomus, which are furnished with a byssus. The second, *Uniodæ*, will embrace Unio, Ilyiria, Anodonta, and Iridina. They want a byssus.

M. Cuvier is disposed to place in this group the genera Cardita, Venericardia, and Crassatella.

2. *Tribe.*

Cloak closed posteriorly, and anteriorly forming three apertures. The first serves for the passage of the byssus, and is the largest. The second admits water to the branchiæ and mouth: and the third is opposite the anus The valves are closed by one adductor muscle There are only two genera belonging to this tribe, Tridacna and Hippopus.

In the two remaining tribes there are three openings in the cloak. Two of these are posterior, and near each other; sometimes, indeed, they are tubular and united. There is no byssus, but always a foot.

3. *Tribe.*

Anterior opening large, allowing the water free access to the mouth and gills, and the feet freedom of motion. The structure of the animals is yet too imperfectly examined, to enable any one to establish families on permanent characters. The attempt which Lamarck has made may be considered as a complete failure, independent of the wanton changes of nomenclature with which it is chargeable. The following are the principal genera belonging to this tribe: Chama, Isocardia, Cardium, Donax, Cyclas, Corbis, Tellina, Loripes, Lucina, Venus, Capsa, Petricola, Corbula, and Mactra.

4. *Tribe.*

Anterior opening small, and not exposing the mouth or gills.

In this tribe the mantle is closed in front; and even when the valves are open, neither mouth nor gills are visible. The anterior opening serves for a passage to the foot, and the posterior openings, in the form of two long tubes, united by a common membrane, serve for the entrance and exit of the water to the mouth and branchiæ, and the ejection of the fœces, the dorsal syphon serving the latter purpose. The cuticle of the shell covers also the exposed portion of the cloak, so that, when the animal is removed from the shell, it remains as a loose membrane on the margin of the valves, as was first observed by Reaumur. All the genera prefer concealment, burrowing in sand, mud, or wood, with the head downwards, and the syphons rising to the surface. The following genera belong to this tribe: Mya, Lutraria, Anatina, Glycemeris, Panopea, Pandora, Gastrochena, Byssomia, Hiatella, Solen, Sanguinolaria, Pholas, Teredo, and Fistularia.

II. Section.

ACEPHALA TUNICATA.

Covering soft or coriaceous:

The formation of this interesting group of animals was first publicly announced by Lamarck in his *Histoire Naturelle des Animaux sans Vertebres*, Tom. III. p. 80 (1816). The labours of Desmaret, Lesueur, and Cuvier, aided by the descriptions of Ellis and Pallas, paved the way for the masterly efforts of Savigny, to whom we owe the most extensive, new, and accurate information yet given concerning the animals of this group. His observations are contained in his *Recherches Anatomiques sur les Ascidies composées, et sur les Ascidies simples*, inserted in his *Memoires sur les Animaux sans Vertebres*. 8vo. Paris, 1816.

The covering of the animals of this group consists of an external and internal sac or tunic, which are either entirely united or unconnected, except at the apertures. The surface is smooth in some, and rough in others, and in a few species defended by an artificial covering of agglutinated shells and sand. The sacs are furnished with muscular bands, and are capable of contraction. Some of the species, by means of contractile movements, float about in the water; others, receiving that element into the branchial cavity, and ejecting it forcibly at the opposite one, push themselves forward. Many, however, are fixed during life to seaweeds and stones.

The apertures of the tunic are two in number, unless in the doubtful genus Mammaria. The one, frequently the largest, is destined for receiving the water into the cavity to supply the mouth and gills. This is termed the *branchial* cavity. The other is destined for the exit of the water, the eggs, and the fœces, and termed the *anal* opening. These apertures are sometimes placed near each other, at other times at opposite extremities of the body, and variously provided with tentacula or valves.

The mouth is simple, destitute of spiral arms, and opening in the interior of the cavity of the body between the branchiæ, as in the other Acephala. It possesses neither jaws nor tentacula. The alimentary canal is very simple, and can scarcely be distinguished into gullet, stomach, and intestine. The food is soft, and such as the bounty of the waves bestows. The liver adheres to the stomach, and in many species is divided into distinct lobes.

The circulating system appears to be reduced to a single systemic ventricle. The gills cover the walls of the cavity, in the form of ridges, more or less complicated, and seldom symmetrical.

The reproductive organs consist of an ovarium, either simple or complicated, with some additional glands, the uses of which have not been ascertained. They are considered as hermaphrodite, and independent of reciprocal impregnation. They appear not only to be oviparous, but to be gemmiparous and compound, many individuals being organically connected, and capable of simultaneous movements. They are all inhabitants of the sea.

1. *Subdivision.*

Interior tunic detached from the external one, and united only at the two orifices.

The branchiæ are large, equal, and spread on the central walls of the inner sac. The branchial orifice has an inner membranaceous denticulated ring, or a circle of tentacula.

1. *Tribe.*

Body permanently fixed to other bodies.

In this tribe the branchial and anal orifices are not opposite each other, and do not communicate through the branchial cavity. This cavity at its opening is furnished with tentacular filaments. The branchiæ are conjoined anteriorly.

A. Simple.

This division includes the genus *Ascidia* of Linnæus. The individuals are independent of each other, and although they frequently adheret ogether in clusters, they are destitute of a common covering, or organical connection.

1. *Apertures furnished with four rays.*

The animals of this group have the external tunic coriaceous, dry, opaque, rough, folded, and frequently covered with extraneous bodies, or inclosing such. The branchial orifice has four rays, the anal one the same, or divided transversely. The branchiæ are divided longitudinally into persistent regular deep folds.

a. Body pedunculated.

The peduncle, in this division, may be said to have its rise in the summit of the body, which it serves to suspend. The abdomen is lateral. The meshes of the branchiæ are destitute of papillæ.

Genus, *Boltenia.*—The tentacular filaments of the branchial circle are compound. There is no liver, and the ovarium is compound. Only one species is kr m, *B. fusiforme.* Savigny, *Mem.* Tab. i. f. 1. and Tab. v. f. 5. It is the *Vorticella Bolteni* of Lin. and the *Ascidia clavata* of Shaw.

b. Body sessile.

M. Savigny describes this group as a genus, which he terms Cynthia, which he divides into four subgenera.

(A.) Tentacular filaments of the branchial orifice compound. The folds of the branchiæ more than eight in number. The liver distinct, and surrounding the stomach. Ovarium divided, with one division at least on each side the body. The intestine destitute of a rib.

Genus, *Cynthia.*—Meshes of the branchiæ unchanged by the folds. *C. Momus.* Sav. Tab. i. f. 2.

Genus, *Cæsira.*—Meshes of the branchiæ interrupted by the folds. *C. Diona* of Sav. Tab. vii. f. 1. The *Ascidia quadridentata* of Forskael.

(B.) Tentacular filaments of the branchial orifice simple. The folds of the branchiæ eight in number, four on each side, and the meshes uninterrupted Intestine strengthened by a cylindrical rib from the pylorus to the anus. Liver absent or indistinct.

Genus, *Styela.*—Ovarium divided, one division at least on each side. *S. Canopus.* Sav. Tab. viii. f. 1.

Genus, *Pandocia.*—Ovarium single, and situate in the fold of the intestine. The *Ascidia conchilega,* a native species, is the type.

2. *Apertures with indistinct rays, or more than four.*

The external tunic is here soft, easily cut, and translucent. The rays (when existing) of the branchial orifice amount to eight or nine; and those of the anal to six at least. The branchiæ are destitute of longitudinal folds. The tentacular filaments of the branchial circle are simple. Liver indistinct. Ovarium single.

a. Body pedunculated.

The stalk is here placed at the base, and serves to support the body, being of an opposite character from that of the Boltenia.

Genus, *Clavelina.*—Branchial and anal orifices without rays. Angles of the branchial meshes simple. Intestine destitute of a rib. The *Ascidia clavata* of Pallas, and the *A. lepadiformis* of Muller, belong to this genus; the latter of these is now recorded as a British species.

b. Body sessile.

The branchial orifice with eight or nine rays, and the anal with six. The angles of the branchial meshes with papillæ. No liver. A cylindrical rib extending from the pylorus to the anus.

(A.) Tunic and branchial cavity straight.

Genus, *Pirena.*—The branchial sac as extended as the tunic. Stomach not resting on the intestine. *P. phusca* of Forskael is the type, to which Savigny has added three other species. The *Ascidia prunum* of Muller, a native species, is probably of this genus.

Genus, *Ciona.*—Branchial sac shorter than the tunic, and exceeded by the viscera. *C. Ascidia intestinalis,* Lin. is a native example of this genus.

(B.) Tunic turned up at the base.

Genus, *Phallusia.*—Branchial sac extending beyond the viscera into the pouch of the sac. Stomach resting on the mass of viscera. The *Ascidia mentula* of Muller, a native species, is the type.

There are two genera supposed to be nearly related to the preceding, which are involved in great obscurity. The genus *Bipapilaria* of Lamarck appears to be pedunculated, with two apertures, each furnished with three setaceous tentacula. The *Mammaria* of Muller has only one terminal aperture. One species inhabits the British seas.

B. Compound.

The animals included under this division were formerly included in the genus Alcyonium of Linnæus, and placed among the Zoophytes. They are compound animals, many individuals united by a common integument, and arranged according to a uniform plan.

In some cases, there is only one system of individuals in the mass, in other cases, there are many, similarly arranged and contiguous. The tentacular filaments of the branchiæ appear to be distinct. They are destitute of the intestinal rib which occurs in some of the preceding genera.

1. *Branchial Orifice Radiated.*

a. Branchial and anal orifices, with six rays.

(A.) Body sessile. The angles of the branchial meshes furnished with papillæ. The thorax, or cavity containing the branchiæ, cylindrical. The abdomen is inferior, with a stalk. Ovarium sessile, and single.

Genus, *Diazona.*—Body orbicular, with a single system of animals disposed in concentric circles.

The substance is gelatinous. The ovarium en-

 closed in the fold of the intestine. *D. violacea* of Sav. Tab. ii. f. 3.

Genus, *Polyzona.*—Body polymorphous, with many systems disposed subcircularly.

The body is subcartilaginous. The individuals are disposed irregularly around the common centre. Savigny inadvertently termed this genus Distoma, a name long precopied among the Intestina. The *Alcyonium rubrum* of Plancus, and the *Distomus variolosus* of Gaertner, belong to this genus. The last is a native species.

(B.) Body pedunculated.

Genus, *Sigillina.*—Body a solid cone, consisting of a single system of many individuals, irregularly disposed, one above the other.

The thorax is short, and hemispherical. The angles of the branchial meshes destitute of papillæ. The abdomen is inferior, sessile, and larger than the thorax. The single ovarium is pedunculated. *S. australis*, Sav. Tab. iii. f. 2. brought from New Holland, by M. Peron, is the only known species.

b. Branchial orifice only furnished with six rays.

(A.) Body pedunculated. System single, circular, and terminal.

Genus, *Synoicum.*—Anal orifice rayed.

The body is cylindrical. The anal orifice has six very unequal rays; the three largest forming the exterior margin of the central star. The stomach is simple. The angles of the branchial meshes destitute of papillæ. Ovarium single, sessile attached to the bottom of the abdomen, and descending perpendicularly. The *S. turgens* of Phipps is the type. In the month of August 1817, we observed at the Isle of May another species, adhering to a rock, and differing from the *turgens* chiefly in the smoothness of its skin.

Genus, *Sydneum.*—Anal orifice simple and tubular.

The body is inversely conical. The stomach surrounded with glands. Intestine spirally folded. Ovarium pedunculated. The *S. turbinatum* is the only known species, and was sent to Savigny by Leach from the British seas.

(B.) Body sessile, polymorphous.

(a.) Each system with a central cavity.

Genus, *Polyclinum.*—Systems numerous, convex stellular. Individuals arranged irregularly round the common centre. Abdomen inferior pedunculated, and less than the thorax. Ovarium single, pedunculated, and attached to the side of the abdominal cavity, and drooping.

M. Savigny describes one species from the Mauritius, and five from the Gulf of Suez.

(b.) Systems destitute of central cavity, and the angles of the branchial meshes without papillæ.

Genus, *Alpidium.*—Individuals in a single row round the common centre.

The thorax is cylindrical. The abdomen inferior sessile, and of the size of the thorax. Ovarium single, sessile, placed at the bottom of the abdomen, and prolonged perpendicularly. Savigny divides the genus into two tribes. In the first, the individuals are simply oblong, with an ovarium shorter than the body, as *A. ficus* (*Alcyonium ficus*, Linn.). In the second, the individuals are filiform, with an ovarium longer than the body, as *A. effusum* of Savigny, Tab. xvi. f. 3.

Genus, *Didemnum.*—Individuals in indistinct systems.

The thorax is short and subglobular. The abdomen inferior, pedunculated, and larger than the thorax. The anal opening is obscure. The ovarium is single, sessile, and placed on the side of the abdomen. *D. candidum* and *viscosum*, from the Gulf of Suez, are the only known species.

2. *Branchial Orifice simple.*

The species form a thin fleshy crust on stones and sea-weeds. The individuals are stellularly arranged in distinct systems. The branchial orifice is circular and undivided. The abdomen is sublateral, and fixed at the bottom of the branchial cavity. The intestine is small, and the anus indistinct. The angles of the branchial meshes are without papillæ.

Genus, *Botryllus.*—Systems furnished with a central cavity.

The systems are prominent, and consist of one or more regular concentric rows. The ovarium is double, being attached to each side of the branchial sac.

This genus is subdivided by Savigny into *Botrylli stellati*, and *Botrylli conglomerati*. In the first, where the individuals are distributed in a single row, there are some species in which the individuals are cylindrical with approaching orifices, and the limb of the central cavity not apparent after death and probably short, as the *B. rosaceus Leachii* and *Borlassii*. In other species, the individuals are ovoid, with remote orifices, and the limb of the central cavity is always apparent and notched, as *B. Schlosseri, stellatus, gemmerus*, and *minutus*. In the Botrylli conglomerati, in which the individuals are disposed in several rows, there is only one species, *B. conglomeratus*.

Genus, *Eucœlium.*—Systems destitute of a central cavity.

The individuals are distributed in a single row, and the ovarium is single, sessile, and attached to the side of the abdominal cavity. The *E. hospitiolum* of Sav. Tab. iv. f. 4, is the only known species.

2. *Tribe.*

Body free, and moving about in the water.

Genus, *Pyrosoma.*

The body is gelatinous, in the form of a lengthened bag open at the widest end. The individuals are arranged perpendicularly to the axis of the central cavity, super-imposed on one another. The branchial orifice is external, without rays, and with an appendage over its upper margin. The anal orifice is opposite, and terminates in the central cavity. Branchial sac destitute of folds, with a membranaceous ring at the entry. The branchiæ are disjoined. The abdomen is inferior to the branchiæ, and not separated by any contraction. Liver distinct, globular, and retained in a fold of the intestine. Ovarium double, opposite, and situate at the upper extremity of the branchial cavity.

M. Savigny divides the species into *Pyrosomata*

verticilla, having the individuals arranged in regular prominent rings, as *P. elegans* of Lesueur; and *Pyrosomata paniculata,* having the individuals forming irregular circles unequally prominent, as *P. giganteum* and *Atlanticum.*

2. *Subdivision.*

Inner tunic adhering throughout to the external one.

The body is gelatinous, transparent, and simple. The branchial cavity is open at both ends, communicating freely with the anus. The branchial orifice is in the form of a transverse slit, with one edge in the form of a valve, to accelerate the entrance of the water into the cavity. The inner tunic is strengthened by numerous transverse muscular bands, which, by contracting, diminish the diameter of the cavity, and eject the water from the anal orifice, thereby propelling the body through the water. The digestive organs are situate at the inner end of the cavity. The mouth and rectum are simple; the former placed between the two branchiæ, the latter directed towards the anal orifice. The heart is contiguous to the stomach, at the bottom of what may be termed the branchial sac, and is enveloped in a membranaceous pericardium. The branchiæ are double, not incorporated with the walls of the sac, but with two folds of unequal length. The largest is free in the middle, fixed at each extremity, and opposed to the dorsal groove, and traverses the cavity obliquely. The other extends from the base of the first to the extremity of the dorsal groove. The surface of the branchiæ consists of transverse vessels in a single range in some species, and a double range in others.

When young, many individuals often adhere, and form chains and circles. But the fully grown individuals are always detached and single.

This subdivision comprehends the species of the genus Salpa; they are exceedingly numerous, and appear to belong to many different genera. M. Cuvier has given indications of some of these, chiefly derived from the shape. A few are furnished with an elevated crest or fin, as the Thalia of Brown; a few have both extremities rounded or truncated, as *Salpa octofera* of Cuvier; others have one extremity produced, as *Holothuria zonaria* of Gmelin; and even both extremities produced, as *Salpa maxima* of Forskael. The *Salpa moniliformis,* so common in the Hebrides, and first recorded as a native by Dr Macculloch, in his valuable *Description of the Western Isles,* Vol. II. p. 188, and imperfectly figured in its young state, at Tab. xxix. fig. 2, appears to be closely allied to the S. maxima of Forskael, and but very remotely with the *S. polycratica* and *confederata* with which it is compared. This observer states, that "It cannot bear to be confined in a limited portion of water, as it died even in a ship's bucket in less than half an hour." With us, in similar circumstances, those taken in the evening were alive at noon on the following day.

The preparation of molluscous animals for exhibition in a museum is attended with peculiar difficulty. The shells, indeed, need only to be cleaned with a soft brush, and the marine kinds to be steeped in fresh water to extract all the saline ingredients, and dried, when they are fit for the cabinet. The soft parts, however, can seldom be distended by any substance, and dried. They are usually, therefore, preserved in spirits of wine, where but too frequently they appear a shapeless mass. (Q. Q.)

ERRATA.

VOLUME FOURTH.

Page 470, col. 2, line 55, *for* " Untcrthancr," *read* " Untcrthanen."
—— 513, col. 1, line 25, *for* " Almadon," *read* " Almaden"
—— 519, col. 2, line 27, *for* " Ocasia," *read* " Ocana."
—— 520, col. 1, line 51, *for* " Astrato," *read* " Atrato."
—— 521, col. 2, line 29, *for* " Agent," *read* " Agents."
———— line 38, *for* " Velen," *read* " Velez."
—— 523, col. 1, line 26, *for* " Carthage," *read* " Carthago."
—— 524, col. 1, line 46, *for* " Pichinca," *read* " Pichincha."
—— 525, col. 1, line 35, *for* " Meguil," *read* " Miguel."
—— 526, col. 1, line 57, *for* " Bracameros," *read* " Brancamoros."
—— 530, col. 1, line 15, *for* " Mompoi," *read* " Mompox."
—— 533, col. 1, line 55, *for* " Ortin," *read* " Ortiz."
—— 600, col. 1, line 37, *for* " Tobasco," *read* " Tabasco." Lower in the same page the same correction.
—— 601, col. 1, line 38, *for* " after furnishing abundance to the 30,000," *read* " after abundance to the inhabitants amounted to 30,000."
—— 604, col. 1, line 18, *for* " Oyapoe," *read* " Oyapoc."
—— 619, col. 1, line 6 from the table, *for* " Ubzen," *read* " Uelzen."
—— 622, col. 1, line 56, *for* " none of whom," *read* " most of whom."
———— col. 2, line 45, *for* " Leipsigen," *read* " Leipsiger." The same occurs twice more in the same page.
—— 623, col. 2, line 58, *for* " Eimen," *read* " Eimer."

VOLUME FIFTH.

DISSERTATION FIRST, PART SECOND.

Page 24, line 10, *for* " νοητα," *read* " νοητὰ."
—— 28, line 21, *for* " se," *read* " ce."
—— 45, line 12, *for* " ἀδεσποτον," *read* " ἄδεσποτος."
—— 69, line 23, *for* " te," *read* " le."
—— 89, line 26, *for* " sons," *read* " son."
—— 156, line 24, *for* " se," *read* " ce."
—— 223, line 21, *for* " puisq' ainsi," *read* " puisqu' ainsi."
—— 226, line 17, *for* " regenee," *read* " regence."
—— 240, line 32, *for* " philosophie," *read* " philosophe."
—— 245, line 25, *for* " philosophie," *read* " philosophe."

Page 81, col. 2, line 5, *for* " standings," *read* " landings."
—— 84, col. 2, in the wood cut, the lower *B* ought to be *C*.
—— 86, col. 1, line 6, *for* " Geneva," *read* " Genoa."
—— 128, *for* " Tybur," *read* " Tiber."
—— 258, col. 1, line 16, insert " twice" at the beginning of the line, and *read* " violations" *for* " violation."
—— 259, col. 1, line 30, *for* " interpretation," *read* " imputation."
—— 259, col. 2, line 40, *for* " legislature," *read* legislative."
—— 262, col. 2, line 37, *for* " case," *read* " cure."
—— 265, col. 2, line 4 from the bottom, *for* " consequences," *read* " consequence."
—— 266, col. 2, line 17 from the bottom, *for* " verbally," *read* " virtually."
—— 267, col. 1, line 12 from the bottom, *for* " l'impurité," *read* " l'impunité."
—— 269, col. 1, line 21, *for* " exact," *read* " excite."

DIRECTIONS

DIRECTIONS FOR PLACING THE PLATES.

*** The Binder will observe, that the two concluding pages of METEOROLOGY, marked with *Asterisks*, are not to be cancelled.

Printed by George Ramsay and Company.